NewFields

Commonwealth Oil Refining Company, Inc.
Peñuelas, Puerto Rico

Draft RCRA Facility Investigation Work Plan

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Prepared by NewFields

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LIST OF ACRONYMS

AOC	Area of Concern
API OWS	American Petroleum Institute Oil Water Separator
BBLS	Barrels
BGS	Below Ground Surface
BTEX	Benzene, Ethylbenzene, Toluene, Xylene
CAMU	Corrective Action Management Unit
Cat Poly	Catalytic Polymerization
CORCO	Commonwealth Oil Refining Company

DAF	Dissolved Air Flotation
DGA	Diglycolamine
DRO	Diesel Range Organics
EI	Environmental Indicators
EL	Eastern Lagoon
EPA	United States Environmental Protection Agency
EPH	Extractable Petroleum Hydrocarbons
EQB	Environmental Quality Board
FOIA	Freedom of Information Act
GIS	Geographical Information System
GPM	Gallons per minute
GRO	Gasoline Range Organics
H_2S	Hydrogen sulfide
H_2SO_4	Sulfuric Acid
HCC	Houdryflow Catalytic Cracker
HCCU	Houdry Catalytic Cracker Unit
LDR	Land Disposal Restrictions
NPDES	National Pollution Discharge Elimination System
ORO	Oil Range Organics
OXO/CIC	Oxochem Enterprises/Caribe Isoprene Corporation
PAH	Polynuclear Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PREPA	Puerto Rico Electric Power Authority
PRG	Preliminary Remediation Goal
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facilities Investigation
SCS	Soil Conservation Service
SO_2	Sulfur Dioxide
SO_3	Sulfur Trioxide
SRU	Sulfur Recovery Unit
SVOC	Semi-volatile Organic Compound
TCLP	Toxicity Characteristics Leaching Procedure
TPH	Total Petroleum Hydrocarbon
TSDF	Hazardous Waste Treatment, Storage, and Disposal Facility
UCL	Upper Confidence Level
UG/KG	Micrograms per Kilogram
UG/L	Micrograms per Liter
USDA	United States Department of Agriculture
USGS	United States Geological Survey
UST	Underground Storage Tank
VOC	Volatile Organic Compound
VPH	Volatile Petroleum Hydrocarbons
VRU	Vapor Recovery Unit

1.0 INTRODUCTION

This RCRA Facility Investigation (RFI) Work Plan has been prepared by Commonwealth Oil Refining Company, Inc. (CORCO) in response to a letter request from United States Environmental Protection Agency (EPA) dated October 2, 2006, EPA Comment Letter dated December 22, 2009 and EPA Comment letter dated June 1, 2011. The Work Plan addresses all facilities owned by CORCO (the Site). The objectives of this RFI Work Plan are to propose sampling plans for characterization of, and, when appropriate, no further action for, the Areas of Concern (AOCs) at the Site.

As stated in the EPA letter, the deliverable end results of the RFI are to obtain data and other information regarding the nature, extent and rate of migration of releases of contaminants from the Site into the environment, if any. In addition, the purposes include a determination, based on risk assessment, of whether interim corrective measures and/or a Corrective Measures Study are necessary. This document is also intended to provide the database sufficient for CORCO to be able to obtain agreement with EPA for resolution of all regulated environmental issues relating to individual AOCs at the Site. Upon completion of the RFI, the necessary data will exist to complete the risk assessment, with the goal being to assign all areas for a determination that no further action is needed or a determination that corrective measures may be required for each area of the Site.

This RFI Work Plan will address the Site on an area by area basis. Available existing data is discussed to the extent possible. Each area will then be categorized into one of three proposed RFI Action Plans based on past and present area usage and availability of data for risk assessment. This approach is necessary because the existing data coverage varies from area to area. The three RFI Action Plans that will be applied to each AOC are as follows:

Action Plan 1

Data coverage is sufficient and all sample results are less than the corresponding EPA Universal Regional Screening Levels (RSLs). No further action will be recommended for each AOC as defined according to this Plan.

Action Plan 2

Data coverage is sufficient and a risk assessment has been performed and included in this Plan. Based upon the area-specific risk assessment, the risks are acceptable according to current and future anticipated use of each area of the Site that is evaluated according to this Plan. Therefore, no further action is recommended.

Action Plan 3

Data coverage is insufficient to perform risk assessment or no data has been collected. CORCO will collect additional data in accordance with the proposed sampling scope of work associated with Action Plan 3. Based on the results of the sample analysis, previous risk assessments, if they exist, will be updated and additional risk assessments will be performed, as necessary, to determine whether additional actions are required. Thereafter, a description of action items will be created, if needed.

2.0 HISTORY

2.1 Site History Summary

CORCO operated an integrated petroleum refinery at the Peñuelas, Puerto Rico location from 1955 until approximately 1982. Operational history for the period prior to present ownership was obtained through interviews with plant personnel who are knowledgeable of refinery operations during that time and review of available documents. Therefore, the description of the history found in this summary is based upon the best available knowledge of management of CORCO at this time.

At the time of acquisition of CORCO by the current owners, who obtained the company out of bankruptcy in the 1980s, the facilities were converted exclusively to a petroleum products terminal and storage business for lease, using the deep water dock and storage tanks located at the facility. The current owners never operated the refinery facilities. CORCO continues to operate as a petroleum products terminal and storage business. Today, CORCO provides terminal storage of petroleum products for suppliers of a large percentage of petroleum products needed by businesses and residents of Puerto Rico. CORCO does not take title to petroleum products but operates its tanks to store the products of other entities pending transfer to other locations, largely by transport vehicles owned and operated by companies other than CORCO. CORCO also provides storage for petroleum products to be purchased by PREPA from third parties. CORCO charges fees for its storage services of petroleum products and does not set the price for such products.

2.2 Background and Regulatory Review

Prior to acquisition by the current owners, CORCO filed a Resource Conservation Recovery Act (RCRA) Part A permit application for the Site in November of 1980. However, petrochemical operations ceased in approximately November of 1981 and all refinery operations at the refinery area of the Site were suspended in approximately March of 1982. Since the current owners converted the main area of the Site to a petroleum products terminal operation, the RCRA permit application process was terminated because the refinery facilities at the Site no longer managed, stored or treated RCRA hazardous waste.

The following information from the time periods prior to 1982 is derived from historical documents and knowledge of employees. At the time of the 1980 RCRA permit application, the primary portions of the Site related to refinery and storage areas utilized a wastewater treatment system, which consisted of an American Petroleum Institute Oil/Water Separator (API OWS), a dissolved air flotation (DAF) unit, two storage tanks for petroleum products recovered from the wastewater treatment process, an aeration lagoon and an oxidation lagoon. Two cooling ponds were adjacent to the aeration lagoon but received no wastewater streams and were not connected to the aeration lagoon. These ponds only received once-through non-contact cooling water from the refinery cooling system. The cooling water lagoons and the aeration lagoon discharged into

the oxidation lagoon. Collectively, the aeration lagoon, oxidation lagoon, and cooling lagoons are referenced herein as the Western Lagoons.

Available information indicates that the API OWS was upgraded in 1977. The DAF unit was installed at that time for the purpose of improving oil recovery and to aid oil recycling to a process visbreaker unit. The float from the DAF was mixed with the API OWS skimmings. Oil float and skimmed oil from the API OWS were then discharged into two tanks, 1008 and 1030. It is believed Tank 1030 was taken out of service prior to November 1980 and the effective date of RCRA. Tank 1008 was used for this purpose after RCRA became effective. During refinery operations, this slop oil was reprocessed through the refinery visbreaker unit and sold as a product. Effluent from the API OWS and DAF unit were treated biologically in the aeration and oxidation lagoons.

A disposal site was reportedly constructed on a leased property east of the Tallaboa River sometime after January of 1977. This lagoon is referenced as the Eastern Lagoon (EL). At the same time, wastewater treatment efficiency was upgraded through enhancement of the aerators in the Aeration Lagoon in the western lagoon area. Sediments/soils from the Western Lagoons were reportedly transported to the EL.

The 1980 RCRA Part A Permit Application described the EL as a possible future disposal site for API OWS sludge. However, the document also stated that the sludge previously was recycled into road asphalt for the tank farm. According to the permit application, these reuse practices were terminated by November of 1980. There is no documentation regarding the disposition of API OWS sludge after the time of the Part A Permit Application. There is no documentation that the EL was used for disposal after the effective date of the hazardous waste listing for (K049) API OWS sludge. CORCO and its counsel have inquired of all available personnel whether API OWS sludge was placed in the EL after November 1980. None of these individuals recall that such disposals were conducted and no documentation has been located regarding these operations prior to the current ownership of CORCO purchasing CORCO in the early 1980s.

After refinery operations were suspended in 1982, recovered oil from the DAF unit and the API OWS remained in Tanks 1008 and 1030. Once the refinery operations permanently ceased, the recovered material could no longer be recycled to the refinery. As a result, some of the recoverable oil was sold in 1984. Tanks 1008 and 1030 were emptied and closed in 2011under the supervision of, and corresponding reporting to, the EPA and PREQB.

The API OWS remained operational after 1982 for the purpose of recovering oil from storm water resulting from the petroleum terminaling operations. The National Pollution Discharge Elimination System (NPDES) permit for the terminaling portion of the Site (dating back to 1986) has remained in force to regulate possible storm water discharges from the terminal activities. The NPDES permit for storm water discharge has been renewed since 1996. Most recently, the EPA Region 2 designated as complete a renewal application filed in 2007 and the EPA approval was forwarded to Puerto Rico's Environmental Quality Board (EQB), which issued the corresponding Water Quality Certificate on December 16, 2011. The renewed NPDES Permit was finally issued by PR EQB on January 1, 2013.

2.3 1990 Consent Order

In 1990, EPA and CORCO entered into a settlement agreement and consent order with the EPA to, among other issues, close the seven units at the Site (East Cooling Water Lagoon, West Cooling Water Lagoon, Oxidation Lagoon, Aeration Lagoon, Eastern Lagoon, and Slop Oil Tanks 1008 and 1030) in accordance with RCRA requirements. An additional requirement of the 1990 agreement is the preparation of an RFI to address free product hydrocarbons in groundwater. All of the defenses of CORCO were reserved by the terms of the referenced agreement.

From 1990 through 1998, CORCO and the EPA engaged in negotiations and proceeded to address several issues toward preparation of the RFI. In 1999, CORCO completed a comprehensive environmental audit, which was submitted to the EPA in April of 1999. The audit proposed closure plans and provided concepts for managing the environmental issues at the Facility. By this submission of the RFI Work Plan, CORCO is in compliance with the requirements of the 1990 Consent Order.

2.4 2000 RCRA Unit Work Plan

In 1999, CORCO prepared and submitted plans to EPA for closure of the seven units in accordance with RCRA. The plans included revisions of water/wastewater treatment alternatives including possible reactivation of the units and construction of a new separate wastewater treatment facility. CORCO and NewFields met with EPA regarding the RCRA Unit Closure Plan in July of 1999.

In March of 2000, EPA requested that CORCO submit either a notification of intent to implement the previous closure plans or submit an alternative plan by May of 2000. In May 2000, CORCO submitted a revised RCRA Units Closure Plan to EPA and in December 2001, CORCO submitted an addendum to this plan. The EPA partially commented upon the RCRA Units Closure Plan in March of 2004 addressing two of the seven units, Tanks 1008 and 1030, and requested that CORCO proceed with their closure. CORCO prepared and submitted in January of 2005 a closure plan for these tanks. In September of 2006, EPA approved the Tank 1008 and 1030 Closure Plan. Since the approval, CORCO has removed all materials from Tanks 1008 and 1030 and has closed these tanks in accordance with the EPA approved closure work plan. The final closure report was provided to the EPA by CORCO in June of 2011.

In August of 2006, the EPA requested that CORCO perform characterization sampling of the Eastern and Western Lagoons for the determination of hazardous waste characteristics. A Characterization Sampling Work Plan for the Eastern and Western Lagoons was submitted in September of 2006 and approved by the EPA later during that same month. The results of this sampling confirmed that these lagoons did not contain characteristic hazardous waste.

In October of 2006, EPA sent a letter to CORCO requesting the preparation of an RFI Work Plan for the Site.

2.5 Other Actions

While EPA and CORCO addressed aforementioned closure plans and investigations, several interim steps occurred which address environmental issues at the Site as follow:

- In July of 2000, CORCO characterized and disposed of drummed and bagged materials on the Site and removed acid materials from Tanks 751, 753, 1101 and 1103.
- In November of 2000, the Puerto Rico Electric Power Authority (PREPA) prepared a Phase II Environmental Site Assessment of the property in conjunction with a possible purchase by PREPA of CORCO.
- In December of 2001, CORCO prepared Acid Tanks 751, 753, 1101 and 1103 Closure Report.
- In January of 2003, CORCO prepared a report for soil sampling at former UST areas.
- EPA requested RCRA 3007 Information for the Site in February of 2004; the report in response to the EPA's request was submitted in April of 2004. Also at that time, CORCO submitted an updated Historical Free Product Evaluation Report to EPA.
- In October of 2004, EPA requested that CORCO prepare an Environmental Indicators (EI) Report.
- In February of 2005, CORCO submitted an EI report entitled "Existing Data and Identified Data Gaps"; EPA met with CORCO regarding the EI in March of 2005.
- CORCO submitted the EI Report in September of 2005 and the EPA issued a Documentation of EI Determinations in November of 2005.
- In November of 2005, CORCO prepared a Health and Safety Plan for Soil Disturbance Activities.
- In August of 2006, EPA sent CORCO a letter requesting testing for characteristics of hazardous wastes at the Eastern and Western Lagoons.
- In June of 2011, CORCO submitted a closure report for Tanks numbers 1008 and 1030.

2.6 Acid Tank Cleanout and Drum Disposal

During the summer of 2000, CORCO voluntarily removed acid materials used in former refinery operations from tanks 751and 753, which were located at the CORCO Main Site, and Tanks 1101 and 1103, which were located at the Oxochem facility. The details of this cleaning operation are provided in the report entitled "Closure Certification Report Acid Tanks 751, 753, 1101 and 1103 for CORCO", dated December, 2001. The tank materials were characterized and neutralized by adding a mixture of lime, cement kiln dust and water, and ultimately disposed in accordance with regulatory requirements. Any visibly impacted soils from around the tanks were removed and neutralized along with the acid material. Tanks 751 and 753 and their associated piping were demolished and the steel was sold for recycling. Tanks 1101 and 1103 were cleaned and remain empty in place. These tanks were cleaned, in accordance with good engineering practices, other best management practices and applicable regulations.

CORCO also addressed more than 2,000 drums and bags of solid and liquid product, intermediate materials and raw materials used during refinery operations. The various drums and

their contents were characterized, consolidated according to compatibility, and disposed in accordance with regulatory and disposal facility requirements. The empty drums were shipped off-site for disposal at a local landfill.

2.7 PREPRA CSA Phase II Environmental Assessment Report

As part of a possible purchase of the CORCO facilities, the Puerto Rico Electric Power Authority (PREPA) engaged CSA Group, environmental consultants, to perform a Phase II investigation at CORCO (CORCO Phase II Environmental Assessment, CSA Group, November 2000). The areas which were evaluated in the CSA Phase II report include the following areas of the Site: the main areas involving the terminal business and the former refinery areas, Western Lagoons, Flores Peninsula, Oxochem, Caribe Isoprene, and the Eastern Lagoon. The data collected during the CSA Phase II investigation have been incorporated into the Site database to be utilized in preparation of the RFI.

2.8 3007 Information Request

EPA requested in February of 2004 that CORCO provide a 3007 response concerning environmental issues at the Site. CORCO responded in April 2004 by sending copies of the following available information to EPA:

- CORCO Health and Safety Plan.
- Historical Free Product Report.
- Tank 1007 Repair Status Report.
- Acid Tank Closure Report.
- Phase II Environmental Assessment.

2.9 Environmental Indicators

In a letter from EPA in October 2004, the EPA asked CORCO to file a report to address Environmental Indicators (EI). CORCO submitted an initial report in February of 2005. After a meeting with EPA in March of 2005, CORCO conducted additional studies with the goal of filling the data gaps in the data necessary for such assessment. The final report from CORCO was completed in September of 2005. The report included a determination that the "risk exposures are within acceptable limits". The final determination report by EPA in November 2005 found "Current Human Exposure Under Control (CA 725)" and "Migration of Contaminated Groundwater Under Control (CA750)".

2.10 RCRA Units - Slop Oil Tanks 1008 and 1030 Closure

Pursuant to the 1990 agreement and consent order between CORCO and the EPA, two of the units proposed for closure in the May 2000 RCRA Unit Closure Work Plan were Tanks 1008 and 1030, also known as the slop oil tanks. These tanks were part of the wastewater treatment system during refinery operations. In a March 2004 letter, EPA provided partial approval of the closure of Tanks 1008 and 1030 and requested that CORCO prepare final closure plans for these two RCRA units. CORCO submitted the RCRA Unit Tanks 1008 and 1030 Closure Plan in June

of 2006. EPA approved the closure plan in September of 2006 and CORCO completed work on closure of these units, with final closure report submitted in June 2011.

2.11 Western and Eastern Lagoons Characterization Sampling

Pursuant to CORCO's May 2000 RCRA Unit Closure Work Plan, in August of 2006, the EPA requested that CORCO perform hazardous waste characterization sampling of the materials present in the remaining units of the Site which were originally addressed in that plan. These units included the Eastern Lagoon, East Cooling Water Lagoon, West Cooling Water Lagoon, Aeration Lagoon and Oxidation Lagoon. CORCO submitted a Characterization Sampling Work Plan in August of 2006. The work plan was approved by email from EPA in early September of 2006 and sampling was completed in September. The results of the sampling disclosed that these lagoons did not contain characteristic hazardous waste.

3.0 REPORTS AND DATA EVALUATED

The following reports and data were reviewed and analyzed as part of the development of this RFI Work Plan. A copy of these reports are provided in the CD ROM attached to this report. These reports were forwarded to the EPA Region 2 with the EI submittal in late 2005:

A. Preliminary Assessment/Site Investigation Final Report, Addendum to Site Assessment Report Prepared by GDC Engineering Inc., dated August 31, 1994;

B. Site Assessment Report, Commonwealth Oil Refining Company Inc., Ponce, Puerto Rico, August 31, 1994;

C. Commonwealth Oil Refining Company, Phase I: Subsurface Oil Investigation Report, EPA I.D. PRD091017228, DSM Project No. 1012-01-01, November, 1994;

D. Monitor Well Installation, Monitor Well Plug & Abandonment, Eastern Oil Lagoon Impoundment Sampling & Monitor Well Level Measurement Addendum Project, February 8, 1995;

E. Eastern Oil Lagoon Area Groundwater Risk Analysis, DSM Project No. 1029, April 1995;

F. DSM Phase II: Subsurface Product Delineation Report, DSM Project No. 1035-01, February 1996;

G. DSM Phase II: Subsurface Product Delineation & Formation Evaluation Work Plan, EPA I.D. PRD09017228, Letter Report on the Findings of the Off-Property subsurface Product Delineation Program dated February 23, 1998;

H. DSM Phase II: Subsurface Product Recovery Simulation Report, DSM Project No. 116-01, April 1998;

I. DSM Phase II: Subsurface Product Recovery System Design, DSM Project No. 1125-01, dated August 14, 1998;

J. Environmental Status Report, Shell Fuel Terminal, Guayanilla, Puerto Rico, DSM Project No. 1130-01, dated October 6, 1998;

K. CORCO Phase II Environmental Site Assessment, CSA Group, November 2000;

L. Soil Sampling of Former UST Areas, CORCO Facility, Peñuelas, PR, GeoEnviroTech, Inc., dated January 13, 2003;

M. Historical Free Production Evaluations, CORCO, NewFields, from April 2004 until the present;

N. Monitoring Wells Installation and Groundwater Sampling at Oxochem/Caribe Isoprene, Peñuelas, PR, On-Site Environmental, July 2005;

O. Potential Receptor Evaluation – Mangrove Land Crabs in the Effluent Channel Area at CORCO, Peñuelas, PR, On-Site Environmental, August 2005;

P. Tier 2 and 3 Subsurface Vapor Intrusion Screening at CORCO, On-Site Environmental, August 2005;

Q. Results of a Site Assessment Program for Environmental Indicators, Main Site, CORCO, Peñuelas, PR, AGES, September 2005;

R. Results of a Site Assessment Program for Environmental Indicators, Jake's Lagoon, CORCO, Peñuelas, PR, AGES, September 2005;

S. Results of a Site Assessment Program for Environmental Indicators, Flores Park, CORCO, Peñuelas, PR, AGES, September 2005;

T. Health and Safety Plan, Peñuelas, PR, NewFields, September 2005;

U. Screening Level Human Health Risk Evaluation of Land Crab Consumption Exposure Pathway, CORCO, Peñuelas, PR, NewFields, September 2005;

V. Documentation of Environmental Indicators Determination, EPA I.D. No. PRD091017228, EPA Region 2, November 2005;

W. Annual Free Product Monitoring Reports, January 2004 Through December 2010, CORCO, Peñuelas, PR, NewFields, 2006, 2007, 2008, 2009, 2010, 2011;

X. Results of a Sediment Sampling Program, Eastern and Western Oil Lagoons, CORCO, Peñuelas, PR, AGES, October 2006; and,

Y. Decommissioning, Deconstruction, and Demolition of Abandoned Refinery Units, Draft Report, CORCO, Peñuelas, PR, NewFields, September 2003.

The data contained in these reports were entered into the project Geographical Information System (GIS) database.

4.0 ENVIRONMENTAL SETTING

The Site is located on the south-central coast of Puerto Rico, approximately 55 miles southwest of San Juan and 7.7 miles west of Ponce (Figure 4-1). The facility includes several properties that were originally part of the Guayanilla – Peñuelas petrochemical complex. The Site includes the following areas owned by CORCO (See Section 4.3 for locations):

- Inactive Refinery including Refinery Unit No.1 (PU No. 1), Refinery Unit No. 2 (PU No. 2), Refinery Unit No. 3 (PU No. 3), a Tank Farm Terminal Area with associated pipelines and ancillary facilities, and Docks 1 and 2 in Guayanilla Bay,

- Inactive OxoChem Enterprises, Inc. Plant,

- Inactive Caribe Isoprene Corporation (CIC) facility,

- The CORCO Effluent Channel for wastewater and storm water discharge into Tallaboa Bay,

- Inactive waste disposal area referenced as the Eastern Lagoon, formerly known as Eastern Oil Lagoon,

- Inactive wastewater treatment facilities in the Western Lagoon Complex; and

- Inactive waste disposal areas located on the Flores Peninsula.

The Refinery and Tank Farm Terminal facilities were used until 1982 for the refining, importation, storage, and distribution of crude oil and petroleum products. Gulf Company facilities, comprised of the old CPI No. 1 and CPI No. 2, and HERCOR facilities are located to the east. PREPA's Costa Sur Power Plant and Shell Oil Company property and facilities are located to the west. Former South Pearl Chemical and Union Carbide were located to the south. Undeveloped land is located north of Puerto Rico Route 2, which runs along the northern boundary of the CORCO Refinery and Tank Farm Terminal Area.

4.1 Historical Facility Description

Prior to termination of refinery activities in 1982, the CORCO Refinery and Tank Farm Terminal were used to manufacture several petroleum fractions and products from crude oil received through CORCO's marine docks and stored in tanks at the facility. The various fractions resulting from the oil refining process were further processed into other products at other facilities within the Guayanilla – Peñuelas petrochemical complex.

The inactive OxoChem facility, presently owned but never operated by CORCO, covers approximately 30 acres. Alcohols were manufactured in this unit from feedstock produced by

the CORCO Refinery and Puerto Rico Olefins (a joint venture of CORCO and PPG Company) using an oxonation process.

The inactive Caribe Isoprene Corporation facility, presently owned, but never operated by, CORCO, was a joint venture with the Mitsubishi and Nippon Zeon Corporation to produce isoprene, which is used to produce rubber. The facility covers approximately 20 acres.

The CORCO Refinery and Tank Farm Terminal included two marine docks with five docking berths and a smaller Propylene Dock, owned and operated by CORCO, and the Tallaboa Dock, which is owned by the Puerto Rico Ports Authority, but formerly operated by CORCO. The docking facilities owned by CORCO were designated as the Refinery, Petrochemicals, and Propylene Docks.

The Refinery and Petrochemical Docks are located at Guayanilla Bay. The Propylene Dock, also located at Guayanilla Bay, was partially dismantled in the early 1970s. The Tallaboa Dock is located in Tallaboa Bay. It should be noted that the Tallaboa pipeline and dock facilities have been historically, and are presently, in use by numerous entities other than CORCO. Historical contamination discovered in these areas is likely not the responsibility of CORCO.

4.2 Physical Setting

The climate, topography, geological and hydrogeological data for the Site is presented in this section.

4.2.1 Climate

According to the Puerto Rico Weather Service (1996), the climate of the area is tropical, hot, and relatively dry. The mean average temperature at the Site is approximately 79° F, varying from a low at night of 70° F to 75° F to a high of 90° F to 95° F during the day. The Site lies in the semiarid foothills region and the dry southern coastal lowlands region. The Tallaboa Valley receives an annual rainfall of 35-50 inches; however, the area remains considerably dry since the evapotranspiration rates are nearly twice the rainfall rates due to temperature and wind conditions. Precipitation occurs throughout the year, but almost 85 percent of the total falls during the May to November “rainy season” (3 to 7 inches per month along the coast). January and February are the driest months, averaging 0.5 to 1.0 inches per month. Most rain occurs during high intensity, short duration convective precipitation events. The region is also occasionally subject to long duration, large precipitation events associated with low-pressure systems (generally during July to October) and the trailing edge of cold fronts moving across the Atlantic (usually during November to March). Winds are commonly from the east at 10 to 15 miles per hour. Native growth on the hills in the Tallaboa Valley consists of cacti and other xerophytes, and irrigation is essential for farming in the area.

4.2.2 Topography

The Site is located in an area that has a topographical relief of approximately 330 feet. Approximately one-quarter of the site is situated in the lower-lying Tallaboa Valley, where elevations range from 0 to 26 feet above sea level, and three-quarters of the property is situated on the southeastern edge of the upland ridge that divides the Guayanilla and Tallaboa River Valleys (Document D).

4.2.3 Soils

The Constancia soils or weathered limestone have been mapped adjacent to the southern portion of the facility area by the United States Department of Agriculture (USDA) Soil Conservation Service (SCS). The Constancia soils are described as somewhat poorly drained and calcareous throughout. They are noted to occur on the river flood plain of the semi-rigid area and have formed from the weathering of limestone.

The thickness of the weathered zone was indicated to be in excess of 5-feet in the USDA SCS report. A boring log for a coastal area well, included in the 1972 United States Geological Survey (USGS) report shows mostly clay to a depth of 64 feet below ground surface (bgs) before encountering the limestone formation (Document K).

The Quaternary alluvium is reportedly composed of cobbles, pebbles, sand, clay, and sandy clay, with the percentage of fine-grain material generally increasing towards the coast. In the southern part of the Rio Tallaboa, the USGS estimates the maximum thickness to be as much as 150 feet.

Quaternary (Holocene) Swamp Deposits and Beach Deposits have been mapped to the south of the Site. The swamp deposits consist largely of mangrove swamps, a mixture of sand, clay, and carbonaceous debris from mangrove trees. The beach deposits are sandy, locally containing cobbles, and commonly cross-bedded.

The overburden, which consists of recent alluvium, colluviums, man-made fill, sediments dredged from the ocean floor, and crushed Ponce Limestone, covers much of the Site and surrounding area and generally occurs above the water table. The Site is predominantly built on crushed Ponce Limestone. The infiltration characteristics of this unit are important in relation to the recharge of the underlying saturated units. Infiltration capacities of the colluvial soils and fills vary widely across the Site (from very high to very low) (USDA – SCS 1979).

4.2.4 Geology

The Site is located within the Tallaboa-Guayanilla-Yauco-Guánica sub-area of the south coast province of Puerto Rico. This area is characterized by Quaternary (Holocene) alluvium, associated with stream valley deposits, and weathered limestone that overlay the Miocene age Ponce Limestone formation in the southern portion of the Site, and outcropping Ponce Limestone which forms upland hills and ridges on the northern portion of the Site.

The Ponce Limestone, and Oligocene or Miocene age limestone, is described on the USGS 1978 Geological map as a very pale orange to grayish orange, generally crystalline calcarenite (cemented calcareous sand), containing abundant internal fossil molds (especially mollusks and

solitary coral), echinoids, oyster shells, and foraminifera tests. The thickness of the Ponce Limestone is reported to be over 600 feet to the north of the Site, and possibly approaching 2,500 feet at the Site. The Ponce Limestone commonly strikes east west, with dips south at about 10 degrees. Individual dips range from 10 to 30 degrees to the south, with dips rarely greater than 20 degrees. However, the 1978 USGS map reference indicates a dip measurement of 28 degrees to the southeast and a strike of north 33 degrees east along the northern Site boundary.

4.2.5 Surface Water

Surface water in the vicinity of the Site includes natural and manmade features. The most prominent natural features are Guayanilla Bay, Tallaboa Bay, and the Guayanilla Bay Inlet. The Tallaboa River is situated between the CPI-2 and OxoChem Plant draining southerly to Tallaboa Bay. Manmade surface water features include the Western Lagoons comprised of the Aeration Lagoon, Cooling Water Lagoon West, Cooling Water Lagoon East, and the Oxidation Lagoon. The Eastern Lagoon is inland north of Tallaboa Bay and consists of dikes built around a natural depression. Manmade channels include the Influent Channel, the CORCO Effluent Channel and the channel adjacent to the former Union Carbide property. Other drainage ways that would carry water during infrequent precipitation events include road ditches, swales, and overland routes.

4.2.6 Groundwater

The Subsurface Quaternary Alluvium and Ponce Limestone are reportedly unconfined water bearing (Document K). The course-grain alluvial deposits form the principal aquifer in the Tallaboa Valley. The Ponce Limestone has varying porosity and permeability; primary porosity and permeability range from very low in some of the marls and indurate limestone strata to high or very high in some of the calcarenites and rubble limestone. Exposures in local road cuts indicate that the individual limestone strata are often continuous for hundreds of feet more, so that a given permeability layer may significantly retard groundwater flow. Conversely, high-permeability strata can be important conduits for groundwater migration. Water-yielding capacities are highest in the Tallaboa valley where wells completed in the mixed alluvial sand and gravel layers can produce rates high as 260 gallons per minute (gpm). Enhanced secondary porosity and permeability from dissolution of limestone by formation waters results in openings and cavities that can yield moderate supplies of water; thus making some of the high-permeability strata of the Ponce Limestone important conduits for groundwater migration. The lowest permeability at the CORCO Complex occurs in the impervious limestone strata and the older reddish to brown alluvial deposits (silty clays) that overlie portions of the Ponce Limestone. These two lithologic units can be classified as aquicludes, low-permeability units that can retard the migration of groundwater vertically from one unit to another.

Although the Ponce Limestone typically does not exhibit features indicative of extensive karstic development; limestone strata in the vicinity of the Site have developed secondary porosity as a result of dissolution. In nearby limestone outcrops, there is evidence of large variations in weathering and rock fragmentation parallel to the bedding surface, leading to the formation of cavities and solution-enlarged bedding planes. Similar features probably developed in the now-buried limestone when exposed pockets of reddish brown silty clay within the limestone, which

may represent cavity-fill material, are present in some of the boreholes drilled in the Ponce Limestone at the Site.

A close correlation exists between the water levels and precipitation at the Site, which indicates that the contribution of local rainfall to groundwater recharge is significant. Typically, the lowest water levels at the Site occur during the dry months and the highest water levels occur during the wettest months. The shallow groundwater beneath the Site generally flows to the south. The rate of groundwater movement is controlled by the permeability of the geologic material and the hydraulic gradient. Water-table gradients vary throughout the Site and may change seasonally at any given location.

The materials that underlie the Site can be grouped into three general hydrogeological units: loose and soft marine-lagoon sands and clays; stiff to very stiff alluvial sand and clay; and thin-to medium-bedded, south dipping limestone strata. Local precipitation is an important source of groundwater recharge for the marine-lagoon sands and clays and alluvial sands and clays in which the local water table gradient determines groundwater flow. A significant portion of the recharge for the saturated limestone, which occurs beneath the Site at depths ranging from 20 to 270 feet bgs, may take place in the limestone hills that enclose the Tallaboa drainage basin at a distance of 2 to 5 miles to the north. The limestone contains layers of differing permeability, and, therefore, groundwater may flow preferentially down the dip of the strata. None of the existing monitoring wells tap the limestone at depth.

As indicated in the Document K, an increase in salt-water concentration through intrusion from the sea has adversely impacted freshwater supply particularly from deep wells located south of Road PR- 127 and to the east and west of the Rio Tallaboa. Local groundwater is not potable. The local population does not rely upon groundwater as a drinking water source.

4.3 Description of CORCO Areas

This RFI Work Plan includes the areas owned or operated by CORCO that make up the Site. There are nine areas as listed below, which are shown on Figure 4-2.

Area 1 - CORCO Main Area of the Site - main tank farm and ancillary/support activities and services, and former refinery units located north and south of Highway 127.

Historical Use

Tank storage and petroleum refinery unit operations including crude oil, intermediate and finish petroleum products such as gasoline, diesel, No. 6 fuel oil, kerosene, naphthalene, aviation fuel and sulfuric acid. Products were generally brought into CORCO through the deep water docks, pumped into tanks for storage and subsequently were shipped out through either the deep water docks, truck loading rack or local pipelines to adjacent petrochemical facilities.

Current Use

Tank farm storage for petroleum products including unleaded gasoline, diesel, No. 6 fuel oil, waste oil and fuel additives. Products are brought into CORCO through the deep

water docks, pumped into tanks for storage and subsequently are shipped out through either the deep water docks, or the truck loading rack to local Puerto Rico retailers. The former refinery units have been dormant since 1982 and are intended for eventual demolition. Figure 4-3 shows the location and status of the storage tanks on CORCO Main Site.

Area 2 - Western Lagoons

Historical Use

The Western Lagoons consists of former treatment ponds, channels and former lagoons used during refinery operations. Wastewater treatment for refinery operations process wastewater occurred in the Aeration and Oxidation Lagoons. Once through cooling water was handled in the East and West Cooling Water Lagoons. The Effluent Channel was used for the discharge of once through cooling water, treated process wastewater and storm water runoff from the site. Sediments excavated from the treatment ponds during maintenance cleanouts were disposed in Jake's Lagoon.

Current Use

All former treatment ponds (Aeration and Oxidation Lagoons and the East and West Cooling Water Lagoons) are no longer in service. No process or storm water flow from the main areas of the Site enters these ponds and therefore they are hydraulically isolated from the surrounding areas. The Effluent Channel currently serves as the discharge channel for the majority of storm water which is discharged from the main areas of the Site. A storm water monitoring station has been installed at the Effluent Channel as NPDES outfall 003. Future planned use of the Effluent Channel will include the discharge of process wastewater from the facility industrial wastewater treatment plant once it is constructed. Figure 4-4 shows the location of the individual lagoons that make up the Western Lagoons.

Area 3 - Flores Peninsula

Historical Use

Flores Peninsula was originally formed during the construction of the CORCO refinery areas of the Site. Spoil material which resulted from refinery and tank farm foundation excavations were placed in Guayanilla Bay to form Flores Peninsula. Flores has been used for a variety of purposes over the years including as an equipment lay down area, a park for CORCO employee picnics and as dredge spoil disposal area.

Current Use

Flores Peninsula is currently used for equipment lay down area, a park for CORCO employee picnics and as dredge spoil disposal area.

Area 4 - Oxochem and Caribe Isoprene Corporation

Historical Use

The Oxochem and Caribe Isoprene Corporation areas of the Site were not owned or operated by CORCO. CORCO obtained these properties as a result of distribution of assets following the CORCO bankruptcy. Historically, CORCO had sold petroleum products to Oxochem for the production of Oxo alcohols such as butanols and 2-ethylhexanol which are commonly used to produce plasticizers. CORCO also sold petroleum products to CIC for the production of isoprene which is typically used in the production of synthetic rubber. Neither of these facilities has operated since the 1980s when CORCO owners acquired these areas of the Site.

Current Use

Both Oxochem and CIC are inactive. CIC is believed to have had most if not all process units and vessels drained and steam cleaned. Oxochem is reported to have been mothballed which would have included draining and steam cleaning of all process units and vessels. The Oxochem and CIC facilities are proposed for demolition.

Area 5 - Eastern Lagoon

Historical Use

CORCO personnel understand that the Eastern Lagoon was a shallow excavated area constructed for the purpose of disposal of sediment materials removed from Jake's Lagoon around 1977. To the best knowledge of CORCO management and experts, no further disposal occurred after 1982.

Current Use

CORCO has acquired ownership of the EL property which is included in the Site and has secured the area with a fence. The area has a berm around it and does not hold rain water. The area is covered with trees.

Area 6 – Area North of CPI No. 2

Historical Use

This area was not a process operational area in the past. The only industrial uses on this property were for clean water storage tanks and power line right of way.

Current Use

The area north of CPI No. 2 is not currently in use. The water storage tanks are still present and the power line right of way is also still present.

Area 7 – Pipelines and Pump Stations

Historical Use

The pipeline in the main areas of the Site connected the CORCO main areas of the Site tanks to the Guayanilla dock. This pipeline was, and continues to be used to carry raw and finished petroleum products to and from tanker ships to the storage tanks. The Tallaboa pipeline connected the CORCO main area tanks to the Tallaboa dock. The pipeline was used to carry raw and finished products to and from the storage tanks to the ships at the dock. Pump stations were located along the pipelines at various locations as needed to pump the products from the docks to the storage tanks. The pipeline and pump stations for the Tallaboa dock are no longer in use as described in the "Current Use" overview below.

Current Use

The Guayanilla pipeline in the main areas of the Site currently is used for transferring petroleum products to and from the storage tanks to and from ships at the Guayanilla deep water dock. Pump Stations associated with the pipeline located in the main areas of the Site are still in use for pumping product through the pipelines.

The Tallaboa Pipeline Pump Stations are no longer in service. The Tallaboa pipeline is no longer in service. CORCO plans to remove their pipes from the Tallaboa pipeline in the near future. There are several other parties that have used the Tallaboa pipeline by use of their own pipelines or other forms of transport.

Area 9 – CIC Tanks

Historical Use

The Caribe Isoprene Corporation tanks portion of the Site consist of two tanks on land owned by CORCO. The tanks were used to store C5 and C6 hydrocarbons used as feed stock for the CIC operations. The tanks have not operated since 1982.

Current Use

The tanks and land are not in use. The tanks have been cleaned and emptied.

CORCO is presently a petroleum products terminal facility and was, prior to bankruptcy, formerly operated as a petroleum products refinery and petrochemical facility. Therefore, hydrocarbons and metals are the primary constituents of concern for the RFI.

5.0 MAIN AREAS OF THE SITE

The CORCO main areas of the Site, comprised of the tank farm, pipelines and associated ancillary facilities, former refinery and docks, are designated as Area 1 on Figure 5-1. The main areas consist of active and inactive product and water storage tanks used in the CORCO terminal business, former refinery units Nos. 1, 2 and 3, warehouses, office buildings and other support facilities. The storage tanks are located both north and south of Puerto Rico Hwy 127. The majority of the main areas of the Site are utilized in active commercial terminal operations, although some individual tanks and the former refinery units are not being used.

5.1 Groundwater

5.1.1 Free Product

5.1.1.1 Area Description

Free phase petroleum product is present on the groundwater beneath the main areas of the Site. The main areas of the Site include, among other facilities, the product storage tank farm and former refinery units. The refinery and tank farm began operations in the 1950's. The refinery ceased operations in 1982 and the tank farm remains in operation today. Free product recovery remediation of historically contaminated groundwater began in the mid 1990s and are ongoing. Recovery operations have removed in excess of 7,312,990 gallons of free product (as of December 2012) from the subsurface which is disposed for recycling. CORCO also monitors the product thickness on a monthly basis. This data is compiled, summarized and provided to EPA and EQB in annual reports. The latest Free Product Monitoring Report was submitted to EPA and EQB in August 2012. The monitoring and pumping well network is shown in Figure 5-2.

5.1.1.2 Existing Data

An extensive database of free product thickness exists from the mid 1990's through the present. CORCO has also sampled the product for characterization purposes. It contains significant amounts of benzene, toluene, ethylbenzene and xylene (BTEX) indicating that such free phase material is petroleum products. The existing data indicates a decreasing trend in free product thickness within the heart of the plume over time (Figure 5-3). This decreasing trend has been well documented in each of the annual Free Product Monitoring Reports.

There are two areas of the free product plume where the boundary conditions were not well defined (Document W). One area is to the southeast along the boundary with Union Carbide. The second area is to the southwest along the boundary with former Shell Fuel Terminal (Shell). In an effort to obtain available data from the adjacent properties, CORCO representatives reviewed files at the EPA and Puerto Rico EQB offices pursuant to a Freedom of Information Act (FOIA) request and a Puerto Rico open records request. The results of the file review for Union Carbide property indicate that there is no significant free product in boundary wells along the southern boundary between CORCO and Union Carbide.

With regard to the boundary between the CORCO property and the former Shell Terminal property, the Shell data indicates there was a significant free product plume present on the Shell site which is the result of operations at the now closed Shell facility. Reports also indicate that there are operations being undertaken by Shell to monitor and recover this product from their site. CORCO has reviewed the free product data along its boundary with Shell (Figure 5-4). Topography in this area drops off from northeast to southwest along the property boundary, as does the groundwater potentiometric surface. There are 4 wells along this boundary (PD-9, PD-23, PD-30 and PD-31). Recent measurements indicate well PD-30 and PD-31 which are directly upgradient of Shell property have no free product present. Wells PD-23 has approximately 2.75 feet of product and PD-9 has about 3.94 feet of product. Shell reports indicated the product was thickest in the vicinity of their on-site tanks, which were also suspected to be the source for the product.

Table 5-1 contains the existing free product data collected from December 2012 to present at the Main Site which includes the most recent data collected since the last free product report.

5.1.1.3 Risk Assessment

The risk of exposure to the free product plume is from direct human exposure through an existing drinking water well or ecological exposure to oil seeps. Neither of these exposure conditions exists at CORCO as identified in the EI Report (Document V). There is an incomplete pathway for groundwater exposure; therefore, the risk screening will not be carried further at this time.

5.1.1.4 Action Plan 3

CORCO plans to continue with free product recovery and monitoring operations into the foreseeable future. Free product levels continue to be stable or decreasing throughout much of the plume. The boundary to the south along former Union Carbide property has now been delineated and confirmed. No additional wells are planned for this area.

The free product plume on Shell property resulted from Shell's operations as identified in the October 1998 Environmental Status Report, Shell Fuel Terminal (Document J). CORCO has installed two additional monitoring wells in the area south of CORCO and southeast of Shell along north side of Highway 127 as part of the EI data gaps studies. CORCO has also relocated pumping well PW-12 to the proximity of well MSEI MW-7 located near the southwest boundary with Shell. CORCO proposes to actively pump and continue to monitor free product thickness and determine if additional action is warranted. Due to repairs to tank 704, the pumping wells were not in service from January 2011 through June 2012. Four of the thirteen pumps were placed back in service in June 2012. The remaining pumps continue to be out of service because of routine maintenance repairs. CORCO further agrees to delineate impacts from its free product plume up to the property boundary with Shell. Given the locations of monitoring wells PD-09, PD-23, PD-30 and PD-31, which are all located along the property boundary with Shell, CORCO believes it has met its obligation in this area.

For these reasons, Action Plan 3 is applicable to the main areas of the Site. Accordingly, CORCO will continue with free product monitoring, recovery and disposal as summarized above.

5.1.2 Dissolved Product

5.1.2.1 Area Description

Please see Section 5.1.1.1 for the description of the free product recovery area of the Site.

5.1.2.2 Existing Data

Groundwater dissolved phase analytical sampling data of petroleum constituents were collected from a select set of the wells located at the main areas of the Site in 2000 and 2005 (See Documents K and Q). These samples were analyzed for diesel range organics (DRO), gasoline range organics (GRO), oil range organics (ORO) and BTEX. The sample results indicate the boundary remains undefined for dissolved phase hydrocarbon compounds. Table 5-2 provides a listing of all groundwater dissolved constituents summarized by area and well.

CORCO has confirmed the direction of groundwater flow beneath the main areas of the Site to the south and southwest (Document Q). The direction of flow, lack of potable or usable water, and lack of public water supply extraction wells confirmed during the water well survey, and lack of oil seeps (Document V) indicate the pathway is not complete for dissolved phase groundwater constituents.

The analytical data of the free product recently collected by CORCO confirms that groundwater dissolved constituents of concern (COCs) are BTEX and naphthalene. Based on the review of former Union Carbide dissolved product data, the boundary wells between CORCO and former Union Carbide contain dissolved BTEX.

5.1.2.3 Risk Assessment

The risk of exposure to the dissolved product plume would come from direct human exposure through an existing drinking water well or ecological exposure to oil seeps. Neither of these conditions exists at the CORCO Site. The EI concluded that there is no risk exposure to free product in groundwater because the pathway is not complete. Therefore, risk screening for exposure to dissolved groundwater constituents is not necessary.

5.1.2.4 Action Plan 3

Past trends in the free product plume extent and thickness indicate a continuing decrease over time. As the free product plume continues to be reduced, it is appropriate to begin dissolved product monitoring of boundary conditions in select locations at the site where there is no free product present. The purpose of this dissolved monitoring is to establish a time series data

record to evaluate trends. Wells where free product is observed will not be sampled for dissolved constituents. CORCO proposes to sample the wells located at Jake's Lagoon as described in Section 6.5.3.2. The Jake's Lagoon wells provide a boundary between the plume located on the main areas of the Site and Guayanilla Bay to the west.

With regard to the boundary with former Union Carbide property, no further sampling for dissolved constituents will be taken due to the presence of trace amounts of free product. CORCO has installed wells along the boundary with Shell and free product remains present in many of these boundary wells. CORCO also operates a mobile trailer mounted free product recovery system to remove free product from this area. No dissolved product sampling will be performed here until free product recovery is complete.

5.1.3 Vapor Intrusion

CORCO proposes to include vapor intrusion (VI) as a component of the RFI Work Plan. CORCO will perform an assessment of the potential VI risk to occupants of the main areas of the Site buildings as a result of the free or dissolved product plume. This work will be done in accordance with applicable guidance.[1]

5.2 Former Refinery Units

The Former Refinery Units 1, 2, and 3 (refinery units) and the Rundown Tanks (Figure 5-5), which are part of the main areas of the Site, were shut down in 1982 and remain inactive to this day. The Decommissioning, Deconstruction and Demolition (DD&D) of Abandoned Refinery Units Report, dated September 2003 (Document Y) is a compilation of available information about materials that could be present in the former refinery units.

5.2.1 Refinery Plants 1, 2 and 3

When the refinery facility was shut down, an undetermined amount of the process materials and catalysts were left in vessels, although some materials were gravity drained (Document Y). The refinery units mainly consist of enclosed vessels and piping, are located above grade on a thick concrete pad and are surrounded along most of its perimeter by concrete paving and curbing.

While it is possible that there are lighter material still in the systems under pressure, it is more likely that the lighter organics have volatilized and are no longer present, leaving heavier low vapor pressure organic materials, organic sludge, spent acids and caustic, and their corresponding sludge. It is also likely that the cat cracker units still contain spent/contaminated catalysts, the various heaters contain coke, and the lube oil reservoirs contain aged/contaminated oils. Possible additional residues may include salts, metals, sulfur, amines and phosphoric acid.

[1] OSWER Final Guidance for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Sources to Indoor Air, Review Draft, 04-11-2013

5.2.2 Rundown Tanks

The rundown tanks were integrated as part of refinery units and were directly connected to the refinery by permanent piping. These tanks were used to store and facilitate transfer of products to-and-from the refinery units. The material type and volume in the run down tanks are assumed to be consistent with their usage during refinery operations.

5.2.3 Material Inventory

CORCO has prepared Table 5-3 which provides a best estimate of the materials and volumes of materials present in the former refinery units. These materials would be detected as being present in the environment using VOC, SVOC and metals analysis. The various parts of the refinery units were shut down with an undetermined amount of the process materials left in place.

5.2.4 Materials Recovery and Disposal

As part of the planned DD&D of the former refinery units, the products inventoried in the preceding section will be evaluated for commercial value and disposal characteristics. Based on the results of the materials inventory and testing, products that are of commercial value will be removed and sold. Products that have no commercial value or no identified user will be tested for hazardous waste characteristics and disposed in accordance with applicable regulations. After removal of these materials from the area, the vessels, piping, concrete pad and equipment will be decontaminated to the extent practical and the wastewater from this operation will be treated on-site or disposed off-site, as applicable. Metal vessels and piping will be recycled as salvage or scrap material and the concrete foundations and footings will remain in place.

5.2.5 Existing Data

There are four locations that have been sampled within the immediate vicinity of the refinery units or run down tanks, although two additional nearby areas have been sampled (Figures 5-6 through 5-8). The results of these borings are posted on the Figures. All results, with the exception of arsenic, are below EPA Regional Screening Levels (RSLs)[2]. Although there are no groundwater wells within the refinery units, available information suggests that the site wide free product plume extends beneath the refinery units (Document W).

5.2.6 Risk Assessment

Please see Attachment C - Human Health and Ecological Risk Assessment for a description of the risk assessment.

[2] Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites. United States Environmental Protection Agency. June 2011.

5.2.7 Action Option 3

Sampling Approach for the Refinery Units of the Main Areas of the Site.
Once the refinery units have been decommissioned and decontaminated as part of the DD&D process, an area wide soils investigation will be performed at the refinery units, including sampling of surface and subsurface soils. The samples will be collected at the refinery units using a traditional auger type rotary drill rig, a portable auger rig, a hand auger and/or geoprobe DPT rig for sample collection depending on site access limitations, cost and equipment availability.

Field Screening
A hand held photoionization detector (PID) will be used to screen the samples as they are collected. The purpose of the PID is to identify hot spots for volatile contamination. The PID will also be used to identify the location for sample collection in the vertical sample core. The PID has a detection limit of 1 part per million (ppm) for total VOCs. This detection limit is sufficient for source delineation and high mass migration given the levels expected for screening purposes. The borings will be advanced to 1 foot depth if ecological risk only samples and up to 10 feet depth if human health risk samples. Borings will be advanced to the designated depth or groundwater whichever occurs first. The rationale for the sample intervals is provided below:

1. Zero to 1 foot bgs – Eco risk and human health surface soil exposure risk
2. 1 to 4 feet bgs – Human health site personnel and trench exposure risk
3. 4 to 10 feet bgs – Human health construction (foundations or basement) worker exposoure risk

A surveyor or GPS will be used to locate the sample points. Additional boring locations may be added as needed to delineate areas of concern.

A field hand held XRF device will be used to field screen for metals. The top 1 inch of soil will be removed and a hand auger used to collect the upper 1 foot of soil. The soils will be thoroughly mixed and screened using the XRF. Ten percent of the metals soils screening results will be sampled and sent to the laboratory for RCRA metals analysis. These lab results will be used to correlate the field XRF results with lab metals results for risk assessment. If the initial upper 6 inch screening with the XRF exceeds the industrial standards, or estimated background concentration, for any of the eight metals, additional 1 foot sample intervals will be collected and measured using the XRF. The screening will continue vertically until the results indicate that all eight metals are below industrial standards or estimated background.

Laboratory Analysis Samples
After PID / XRF screening of the sample core a grab sample will be collected from each of the designated sample intervals for lab analysis. The sample intervals are 0 – 1 feet below ground surface (bgs) for ecological and human health risk locations, and 1 to 4 feet bgs and 4 to 10 feet bgs for human health risk locations. The grab sample for each sample interval will be collected from the portion of the sample associated with the highest PID reading. The grab sample will be analyzed at the lab for VOCs, SVOCs, and fractioned total petroleum hydrocarbons (TPH) [volatile petroleum hydrocarbons (VPH) and extractable petroleum hydrocarbons (EPH)]. Approximately 10 metals soils samples will be sent to the laboratory for RCRA metals analysis.

These lab results will be used to correlate the field XRF results with metals concentrations for risk assessment.

Laboratory Sample Hold and Release for Analysis

In an effort to reduce the number of redundant samples analyzed, samples from the 4 – 10 feet intervals will be collected in the field as designated in the sampling plan. The 4 – 10 feet samples will be shipped to the lab and held pending the results of the 1 – 4 feet interval above it. If the upper interval sample meets applicable screening levels (RSLs), then the lower interval will not be analyzed. If the upper interval sample fails RSLs, then the lower interval will be analyzed. Extractions will be completed as needed to maintain appropriate hold times. See QAPP for more information.

Proposed Sampling Locations and Rationale for Number of Samples

The approximate boring locations for the refinery units area and run down tanks are shown in Figure 5-9. The sampling program for the former refinery units was developed through the utilization of Visual Sample Plan (VSP) Software Version 6.0 and EPA guidance for performing field sampling and making remedial decisions. In addition to the locations shown in Figure 5-9, two additional boring will be installed through the slab to a depth of 10 feet bgs each. These borings will be installed through the slab in a low spot or along cracks locations of likely leakage of process wastes from refinery operations. These boring will be field located.

The existing data were used in conjunction with the VSP software to assess the adequacy of the existing data for evaluating site conditions. An objective and null hypothesis are required when using VSP calculations; for the purpose of using VSP, the primary objective of site investigations and sampling analysis is to compare a site median or mean concentration with a fixed threshold criterion, such as the RSLs.

Mean concentrations less than the screening criteria are assumed to present no potential risk to humans; therefore, the working hypothesis (or 'null' hypothesis) for the data evaluation is that the median (mean) value of the contaminants in soil/sediment is less than the threshold criteria (RSL for industrial land use). The alternative hypothesis is that the median (mean) value is greater than or equal to the threshold criteria, which may indicate a potential risk to human receptors. The VSP Software Version 6.1b[3] calculates the number of samples required to reject the null hypothesis given a selected sampling approach, a 95% confidence interval, and other inputs to the associated equation. The number of samples deemed necessary for rejecting the null hypothesis can then be compared to any existing dataset and the need for supplemental data assessed.

[3] The Visual Sample Plan Software was sponsored in part by various federal agencies including the U.S. Department of Energy; U.S. Department of Defense, Environmental Security Technology Certification Program; U.S. Department of Defense, Navy; U.S. Department of Health and Human Services' Centers for Disease Control & Prevention, National Institute for Occupational Safety and Health; U.S. Department of Homeland Security, Directorate for Science and Technology; and, U.S. Environmental Protection Agency's (EPA) Offices of Environmental Information and Solid Waste and Emergency Response

Using the data available for former refinery units, VSP was utilized to determine if the existing data set is adequate to characterize the site soil; alternatively, if the existing data set is not adequate, the number of site soil samples that would be required was determined.

5.3 Inactive Storage Tanks

There are believed to have been 219 tanks on the CORCO main areas of the Site located north and south of Highway 127. Most of these tanks, 179, are either active, idle, or waiting to be placed into service or pending demolition. Eight tanks have been demolished. Ten tanks are not owned by CORCO; they belong to CPI although located on CORCO property. Twenty-two tanks remain with unknown locations. Twenty-one storage tanks are designated as run down tanks. These tanks are addressed in Section 5.2 above. CORCO has prepared a table containing information on the historical usage of each tank on the main areas of the Site (Table 5-4). The status of the tanks is also shown in Figure 4-3.

5.3.1 Existing Data

Existing data for the storage tanks on the main areas of the Site are described in Sections 5.4 and 5.5 below.

5.3.2 Action Option 3

In order to complete the human and ecological risk assessments, additional samples are proposed around Tanks, 704, 727, 604, 741, 903, 926, 932, 934, 933, 972, 978, 997, 998, 1001, 1002, 1007, 1013, 1022, 1023, TK-1, TK-2, T-1, T-2, T-3, T-4, and E-1, as well as along the northern perimeter of the Main Site. The locations of these proposed samples can be seen in Figure 5-10. The rationale for selecting these locations was to; 1) select representative tanks based on historical tank contents, 2) sample most and least likely locations within the selected tank containment dikes, and 3) use these sample results to represent the remaining tanks for the purposes of risk assessment and corrective action.

5.4 Leaded Fuel Handling Area of the Site.

5.4.1 Area Description

The leaded fuel handling area of the Site includes tanks and the Former Drum Storage Area 3 – Pump House #5 where leaded fuels and leaded fuel additives were handled in the past. Leaded fuel additives were mixed into motor fuel gasoline and aviation gasoline. The aviation gasoline tanks were 927, 928, 929 and 930, the leaded motor fuel gasoline tanks were 955, 956, 957, 958, 959, 960, 1001, 1002, 1003, 1004, 1005, 1006 and 1014. Two underground field erected storage tanks 923 and 925, and the additive storage tanks were located as shown in Figure 5-11. Tanks 955, 958, 1001, 1002, 1003, 1004, 1005, 1006 and 1014 are presently used to store unleaded gasoline. Underground storage tanks 923 and 925 are presently filled with a mixture of water and a protective additive. These USTs are “field erected tanks” and covered by EQB UST Registration No. 02-94-0152. (CORCO plans to maintain the registration with EQB on tanks 923 and 925 and will close these tanks in accordance with EQB requirements at the time of refinery demolition.) Two bullet tanks that formerly contained leaded gasoline additive are

located at the northern location of Figure 5-11. One additional tank that contained leaded gasoline additive is located on the southwest corner of the area shown in Figure 5-12.

5.4.2 Existing Data

Former Leaded Fuel Tanks

CSA collected a series of five surface soil samples were collected around each of the fuel storage tanks 955, 956, 957, 958, 1001, 1002, 1003, 1004, 1005 and 1006 (Document K). The fuel storage tanks not sampled were tanks 927, 928, 929, 930, 959, 960, 1014 and the underground tanks 923 and 925. Of these samples only one result was greater than the Industrial Risk Screening Levels (RSLs), and that was the southeast sample at tank 955. The remaining samples at 955 were below residential standards. The northern most leaded additive storage tank was sampled at 2 ft to 4 ft depth intervals. The results of this sampling were non-detect for lead. The southern leaded additive storage tank was not sampled.

Former Drum Storage Area 3 – Pump House #5

One pump station has been sampled by CSA in August 2000. This sampling consisted of nine soil samples at 2 to 4 feet bgs at Former Drum Storage Are 3 - Pump House #5. These samples were analyzed for VOCs, SVOCs, pesticides, polychlorinated biphenyls (PCBs), and metals. Arsenic was detected in every sample at concentrations above the RSL of 1.6 mg/kg. The maximum concentration of arsenic detected was 9.5 mg/kg in soil sample DS3-SB-6. Benzene was detected in 2 of the samples above the RSL of 1,400 ug/kg. The maximum concentration of benzene detected was 39,000 ug/kg in soil sample DS3-SB-7. The concentrations of xylene detected in soil samples DS3-SB-6 and DS3-SB-7 are 440,000 and 790,000 ug/kg respectively, which exceeded the RSL of 420,000 ug/kg. Ethylbenzene was detected in three samples above the RSLs. The highest concentration of 56,000 ug/kg was detected in soil sample DS-SB-6. 1,3,5-Trimethylbenzene was detected in soil sample DS3-SB-6 and DS3-SB-7 at concentrations of 170,000 and 250,000 ug/kg respectively: both of which exceed the RSL of 70,000 ug/kg.

None of the detections for SVOCs naphthalene and 2-naphthalene exceeded the RSLs. The SVOCs naphthalene and 2-naphthalene were found at their highest concentrations in DS3-SB-7, with concentrations of 37,000 and 28,000 ug/kg, respectively. They were also detected in DS3-SB-3 and DS3-SB-4. Pesticides were not detected in any of the samples except for lindane which was found at the trace level of 1 ug/kg in one sample. This was well below the RSL of 1.7 mg/kg. PCBs were not detected**.**

Please see Table 5-5 for a complete list of samples for the main areas of the Site. Please see Figure 5-11 through 5-14 for post plots of the available data for these tanks and for Pump House #5.

5.4.3 Action Option 1 and 3

Former Leaded Fuel Tanks

Tanks 955 through 958 and 1001 through 1006, which were already sampled by CSA, pose no risk and therefore no further action is proposed.

Borings are proposed for Tanks 927, 928, 929, 930, 959, 960 and 1014 mentioned above. Figure 5-15 shows the approximate locations of the proposed borings. Samples will be collected around the perimeter of the product storage tanks. One sample will be collected close to the man way, where feasible. All samples will follow the protocol outlined in sampling proposed for the Refinery Units.

The two USTs are registered with EQB and will not be addressed in this RFI but in accordance with EQB regulations.

Former Drum Storage Area 3 – Pump House #5

No surface soil samples have been collected in this area and some of the subsurface samples have had results greater than industrial standards. Therefore borings are proposed for assessment of human health risk. This area will be sampled as indicated in Figure 5-16, which were based on the prior sampling results which indicated the southeast corner of the area may be impacted above RSLs. The borings will be advanced to 10 feet depth or groundwater elevation whichever occurs first. All samples will follow the protocol outlined in sampling proposed for the refinery units.

5.5 Open Storage Areas

5.5.1 Area Description

Five open areas have been identified on the main areas of the Site in the November 2000 CSA CORCO Phase II Environmental Site Assessment (Document K) and designated by CSA as "drum storage areas". Four of them are located on the Main Site and a scrap yard is located on Flores Peninsula. A sixth area was later identified by CORCO northeast of Tank 1007 and northwest of the East Cooling Water Lagoon at the Western Lagoon Complex. The locations of each of these open storage areas are shown on Figure 5-17.

5.5.1.1 Former Drum Storage Area 1

This area, identified by CSA in its site evaluation report as a former storage and transfer area for 55-gallon drums, was known to CORCO as the former Procon warehouse building and surrounding area. At the time CSA's Phase II Site Assessment was written, the Procon building consisted of a concrete pad, concrete spill containment walls, and an enclosed metal sheet walls. Unlabeled drums and bags of unknown contents, DGA and unused refinery catalysts were stored inside the building. These materials were characterized and disposed in accordance with applicable regulations. Degreasers and cleaning agents were used in a vehicle washing station located on the southwest corner and a former diesel service station located on the western side of the building. The diesel service pumps and underground storage tanks (USTs) have been removed, surrounding soils sampled, and the former UST site was closed in accordance with EQB requirements.

The Procon warehouse building is currently used for temporary storage of materials pending characterization and disposal. The duration of storage is less than 90 days.

5.5.1.2 Former Drum Storage Area 2

At the time that CSA was writing its Phase II Site Assessment, a shed in this former storage area held 20 55-gallon drums of unknown content. This area was known to CORCO as the PNP area. Also found just north of the shed were hundreds of gallon sized cans. These materials were characterized and disposed in accordance with applicable regulations.

5.5.1.3 Former Drum Storage Area 3

The area identified by CSA was known as Pump House 5. This is one of the newer pump stations. Please refer to Section 5.4.

5.5.1.4 Former Drum Storage Area 4

The area identified by CSA was known as an Equipment Parking Area. This area was known to contain scrap metal and several 55-gallon drums. These drums were characterized and disposed in accordance with applicable regulations. Also at this location were at least two gasoline USTs that have been removed. This UST site was closed in accordance with EQB requirements. Please refer to Section 5.2.

5.5.1.5 Flores Peninsula Scrap Yard

The Flores Peninsula Scrap Yard is a fenced area located on the north central portion of the peninsula, between the dredge spoils disposal area and the unpaved road. The scrap yard contains metal scraps, unused piping, and various equipment. It is currently used as a staging area for bulk materials such as pipe, concrete, etc. Please refer to Section 7.0.

5.5.1.6 Western Lagoon Scrap Yard

The Western Lagoon Scrap Yard is located northeast of Tank 1007 and northwest of the east cooling water lagoon in the Western Lagoon Complex.

5.5.2 Existing Data

5.5.2.1 Former Drum Storage Area 1 – Procon Warehouse

Five soil samples were collected by CSA Group in August 2000 at 2 to 4 feet bgs and were analyzed for VOCs, SVOCs, pesticides, PCBs, and metals. No surface samples were collected. VOCs were detected at trace concentrations ranging from 2 to 6 ug/kg for most of the samples, except for DS1-SB-4. In this sample, acetone and methyl ethyl ketone were detected at 85 and 22 ug/kg, respectively. The only SVOC detected was bis(2-ethylhexyl)phthalate, which is plasticizer and a common laboratory contaminant, with a concentration of 49 to 120 ug/kg in five samples. None of these concentrations exceeded the RSLs.

For pesticide and PCB analysis, all sample results were below the detection limit in ug/kg. Based on the results distribution, most of the analytical results for the inorganics tested appear to be consistent with background levels within the area. Arsenic was detected at 2.7 to 12.6 mg/kg in all five samples, which exceed the Industrial RSL.

5.5.2.2 Former Drum Storage Area 2 – PNP Area

Six soil samples were collected by CSA Group in August 2000 at 2 to 4 feet bgs with the exception of one sample which was collected at 1 to 3 feet bgs. These samples were analyzed for VOCs, SVOCs, pesticides, PCBs, and metals. VOCs were detected at trace concentrations, essentially at the limit of detection. Most of the compounds were present at less than 100 ug/kg. Acetone was detected at 100 ug/kg in soil sample DS2-SB-1. N-propylbenzene was detected at 190 ug/kg in the same location. None of these concentrations exceeded the RSLs.

SVOCs were detected at higher concentrations. Bis(2-ethylhexyl)phthalate and diethyl phthalate, which are plasticizers and common laboratory contaminants, were detected in several samples, at estimated concentrations ranging from 47 to 220 ug/kg. The most contaminated sample was DS2-SB-1, where chrysene, fluorine, phenanthrene, and pyrene were detected at 500, 530, 1700, and 250 ug/kg, respectively. None of these SVOC concentrations exceeded the RSLs.

All sample results were below the detection limits for the pesticide and PCB analyses. Based on the results distribution, most of the analytical results for the inorganics appear to be consistent with background levels within the area. Arsenic was detected at 6.4 to 16.4 mg/kg in all six samples, which exceed the RSLs.

5.5.2.3 Former Drum Storage Area 3 – Pump House #5

The Former Drum Storage Area 3 is addressed in Section 5.4 Leaded Fuel Handling Area.

5.5.2.4 Former Drum Storage Area 4 – Equipment Parking Area

Four soil samples were collected by CSA Group in August 2000 at 2 to 4 feet bgs in samples DS4-SB-1 and DS4-SB-2, 2 to 3.5 feet bgs in sample DS4-SB-3, and 2 to 3 feet bgs in sample DS4-SB-4. These samples were analyzed for VOCs, SVOCs, pesticides, PCBs, and metals. All VOC detections were at trace concentrations for most compounds. Acetone, methyl ethyl ketone, and xylene were detected at higher levels; with the higher concentrations being 56, 16, and 13 ug/kg, respectively. None of these concentrations exceeded the RSLs.

The SVOCs detected were 2-methylnaphthalene in sample DS4-SB-2 at 45 ug/kg and bis(2-ethylhexyl)phthalate in all samples ranging from 48 to 140 ug/kg. These two analytes are plasticizers and common laboratory contaminants. None of these concentrations exceeded the RSLs.

All sample results were below the detection limit for the pesticide and PCB analyses. Of the inorganic compounds analyzed, three arsenic samples showed concentrations ranging from 2.0 to

6.7 mg/kg in three samples, which though exceeding the RSLs, seem to be within normal background soil concentrations in the area. Only sample DS4-SB-3 did not detect arsenic.

5.5.2.5 Flores Peninsula Scrap Yard

In July 2000, four soil borings were collected in the scrap yard at Flores Peninsula. The northernmost sample (SY-SB-2) was collected at a depth of 2 to 6 feet bgs. The two southernmost samples (SY-SB-3, SY-SB-4) were collected at depth of 1 to 4 feet bgs and 2 to 4 feet bgs, respectively. The remaining sample (SY-SB-1) was collected at a depth of 8 to 10 feet bgs. These samples were analyzed for VOCs, SVOCs, pesticides, PCB, and metals.

Benzo(a)anthracene was detected in sample SY-SB-3 at 1700 ug/kg and benzo(b)fluoranthene was detected in sample SY-SB-4 at 720 ug/kg, both of which exceed the RSLs. Benzo(a)pyrene was detected in sample SY-SB-2 at 480 ug/kg, SY-SB-4 at 780 ug/kg, and SY-SB-3 t 1200 ug/kg and benzo(b)fluoranthene was detected in sample SY-SB-3 at 2600 ug/kg. These concentrations all exceeded the RSLs.

Nickel was detected in sample SY-SB-3 at 1830 mg/kg, which exceeded the RSLs. Arsenic was detected in samples SY-SB-3 and SY-SB-4 at concentrations of 3.8 mg/kg and 7.5 mg/kg, respectively. These concentrations exceed the RSLs.

In June 2005, five soil borings were collected at depths from ground surface to 4 feet bgs in the Flores Peninsula scrap yard as part of the EI study. All samples were analyzed for BTEX, GRO, DRO, and ORO. All of the sample results from the scrap yard were less than the RSLs.

5.5.2.6 Western Lagoon Scrap Yard

One soil sample was collected by CSA Group in August 2000 at 12 to 14 feet bgs in conjunction with the investigation on the surroundings of Tank 1007 and was analyzed for VOCs, SVOCs, pesticides, PCB, and metals. All VOC detections were at trace concentrations for most compounds. 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, and xylenes were detected at higher levels; with the higher concentrations being 210, 100, and 220 ug/kg, respectively. None of these concentrations exceeded the RSLs.

The SVOCs detected were 2-methylnaphthalene at 100 ug/kg and naphthalene at 44 ug/kg. These two analytes are plasticizers and common laboratory contaminants. None of these concentrations exceeded the RSLs.

All sample results were below the detection limit for the pesticide and PCB analyses. Of the inorganic compounds analyzed, arsenic was detected at 8.7 mg/kg, which exceed the Industrial RSLs, but within apparent soil background level in area.

Please see Table 5-6 for a complete list of sample results for this area. Also see Figures 5-6 through 5-8 for Former Drum Storage Area 2 soil data. Please refer to Figures 5-18 through 5-20 for post plots of the existing sample results for Drum Storage Area 1 and Western Lagoon Scrap Yard.

5.5.3 Action Plan 3

Existing data indicates that subsurface areas do not present a risk. Additional surface sampling is proposed for each of the Open Storage Areas. Figure 5-21 shows the approximate locations of the proposed borings in the Former Drum Storage Areas 1 and 2 and the Western Lagoon Scrap Yard. Former Drum Storage Area 4 is covered by the Former Refinery Units sampling and Drum Storage Area 3 is covered by Pump House 5 sampling. The Flores Peninsula Storage Area is covered by sampling proposed for Flores Peninsula. The boring installation and sampling protocol is the same as that described for the refinery units.

Groundwater in the Open Storage Areas was addressed in Section 5.1 – main areas of groundwater of the Site.

5.6 Former WWTP Components

5.6.1 Area Description

At the time of the filing of the RCRA permit application in 1980, the wastewater treatment system associated with the main areas of the Site consisted of an API OWS, a DAF unit, two storage tanks for petroleum products recovered from the water treatment process, and the Western Lagoons, including the Aeration Lagoon, East and West Cooling Water Lagoons, and the Oxidation Lagoon (see Section 6.0). Please also see Section 2.2 for more history of the OWS and DAF. The API separator was installed below grade and the DAF unit was installed above grade.

The former API OWS and the DAF unit were reportedly cleaned out in the mid 1980's after the refinery was shut down and waste materials in the units were deposited in slop oil tank 1008. At that time, the skimmers in the API OWS were removed and at present, the unit acts similarly to oil water separator boxes for storm water handling system, subject to the storm water pollution prevention plan. The DAF unit is not operational but remains on the site.

5.6.2 Existing Data

There is no existing soils analytical data for the former API OWS and the DAF unit. But these units were reportedly cleaned after shut down of the wastewater treatment plant.

5.6.3 Action Plan 3

Additional soil samples are proposed for each of these units. For the former API OWS, four borings are proposed, one on each side of the unit. The DAF screening samples with four borings evenly distributed around the perimeter of the former DAF unit. In addition, one boring will be collected beneath the DAF unit. The borings will be installed and sampled as described in the Refinery Units section. All borings will be advanced to 10 feet below ground surface or the water table, whichever occurs first.

6.0 WESTERN LAGOONS

The Western Lagoons consist of the former wastewater treatment facility lagoons which were previously actively utilized as part of the active refinery facilities prior to the early 1980s (Figure 6-1). The Western Lagoons are located south of Puerto Rico Hwy 127. The western lagoons areas include separate areas known as Jake's Lagoon, influent channel, east cooling water lagoon, west cooling water lagoon, aeration lagoon, and oxidation lagoon. All of these lagoons, except for Jake's Lagoon, are part of the designated RCRA units which are addressed in the closure work plan which was submitted to EPA Region 2 in May of 2000, amended in December 2001 and approved by the EPA in September of 2006.

CORCO also owns Jake's Lagoon which is located adjacent to the Western Lagoons along the bay.

6.1 Western Lagoons

The Western Lagoons consist of four lagoons (aeration, oxidation, and two cooling water), the influent channel and the effluent channel. The aeration lagoon formerly received the refinery wastewater effluent stream from the OWS and a DAF unit.

6.1.1 Process Details

The process details for the Western Lagoons may be found in Section 2.2

6.1.2 Existing Data

In 1994, Weston and GDC Environmental Engineering performed field sampling of the Western Lagoons by establishing a grid over the two cooling water lagoons and the aeration basin that divided each lagoon into nine equal sized parcels (Document A). Samples were then collected at the intersection of the four transecting grid lines. Residual samples were collected from a boat used to access the sampling location. The grid lines were established using staked ropes pulled over the surface of the three lagoons to provide for a reasonable degree of certainty in describing the sample location. Since the oxidation lagoon is substantially larger, ropes were not stretched over this lagoon. Instead, survey points were staked on the banks of the lagoon, and a boat was again used to access the sample location. Location control was provided by shore monitoring to determine when the boat was in the correct position for sampling. Since the oxidation lagoon is an irregular quadrilateral, the four sampling vertices were oriented to provide the best approximation for dividing the lagoon into equal segments.

The data obtained during the Weston and GDC Environmental Engineering investigations disclose that total petroleum hydrocarbons (TPH) are an indicator of the distribution of contaminated sediment/soil within the Western Lagoons. Soil samples were collected in the areas surrounding the lagoons and sediment/soil samples were collected in the lagoons by GDC in November 1993 and were sampled for a short list of SVOCs, dioxins, and metals. Also analyzed were BTEX and TPH. The following is a review of previous detections in soils and

sediments in the Western Lagoon area. In September of 2006, AGES collected composite soil samples in the lagoons and analyzed them for Toxicity Characteristic Leaching Procedure (TCLP) VOCs.

A complete list of soil/sediment samples are provided in Table 6-1. Figures 6-1 through 6-3 provides post plots of available soil and sediment data in the Western Lagoons.

6.1.2.1 Aeration lagoon

Four soil samples were collected at the Aeration Lagoon in November 1993 by GDC. The samples were non-detect for SVOCs and only trace amounts of the dioxins and furans were detected. Based on the results distribution, most of the analytical results for the inorganics tested appear to be consistent with background levels within the area. Arsenic was detected at a concentration of 2.1 mg/kg in two samples exceeding the RSLs.

VOC concentrations were all below the RSLs. Benzene was detected in only one sample at a concentration of 744 ug/kg; Total BTEX was detected in all four samples ranging from 787 to 44,400 ug/kg. Toluene was detected at concentration ranging from 1,050 ug/kg to 17,500 ug/kg. Xylenes were detected at concentrations of 787 ug/kg to 26,900 ug/kg. TPH, for which there is no RSLs, was detected in all four samples at concentrations ranging from 24,100 to 209,000 mg/kg.

In September of 2006 and as required and approved by EPA, AGES collected five composite soil samples and analyzed them for Toxicity Characteristic Leaching Procedure (TCLP) VOCs. In addition, one 5-point lab composite sample was analyzed for TCLP SVOCs, TCLP pesticides, TCLP metals, TCLP herbicides, and miscellaneous parameters. All TCLP sample results were below regulatory levels.

6.1.2.2 Cooling Water Lagoons

Four sediment and four soil samples were collected in each of the cooling ponds in November 1993 by GDC. Constituents that exceeded the RSLs included: arsenic in five samples ranging from 4.0 to 6.7 mg/kg with the highest concentration in CWE-3-SO; benzene in five samples ranging from 9,560 to 13,800 ug/kg with the highest concentration in CWE-2-SL; and tetrachloroethylene in two samples ranging from 6,790 to 7,440 ug/kg with the highest concentration in CWW-4-SO. The remaining inorganics appear to be consistent with background levels within the area. Total BTEX was detected in 14 of the samples at concentrations ranging from 5,610 to 469,600 ug/kg with the highest concentration in CWE-2-SL.

Several organic constituents were detected in multiple samples in the Cooling Water Ponds at concentrations below the RSLs including: 2-methylnaphthalene ranging from 792 to 431,000 ug/kg; ethylbenzene ranging from 750 to 40,700 ug/kg; naphthalene ranging from 9,600 to 69,700 ug/kg; phenanthrene ranging from 2,270 to 78,000 ug/kg; toluene ranging from 7,440 to 40,400 ug/kg; TPH ranging from 410 to 114,000 mg/kg; and xylenes ranging from 4,860 to 384,000 ug/kg.

In September of 2006 as required and approved by EPA, AGES collected five composite soil samples and analyzed them for TCLP VOCs and Metals. In addition, one 5-point lab composite sample from each pond was analyzed for TCLP SVOCs, TCLP pesticides, TCLP metals, TCLP herbicides, and miscellaneous parameters. All TCLP sample results were below regulatory levels.

6.1.2.3 Oxidation Lagoon

Four sediment and four soil samples were collected in the Oxidation Lagoon in November of 1993 by GDC. Constituents that exceeded the RSLs included: arsenic in seven samples ranging from 1.7 to 6.8 mg/kg with the highest concentration in OL-1-SL and total TCDD in two samples ranging from 0.11 to 1.14 ug/kg with the highest concentration in OL-1-SL. Trace levels of furans were detected and the remaining inorganics tested for appear to be consistent with background levels within the area. Total BTEX was detected in two samples at concentrations of 1,310 to 6,390 ug/kg with the highest concentration in OL-2-SL.

Two organic constituents were detected in individual samples in the Oxidation Lagoon at concentrations below the RSLs including: toluene at 6,390 ug/kg and xylenes at 1,310 ug/kg. TPH ranged from 97 to 60,900 mg/kg in eight samples.

In September of 2006 as required and approved by EPA, AGES collected composite soil samples and analyzed them for TCLP VOCs and Metals. In addition, one 5-point lab composite sample from each pond was analyzed for TCLP SVOCs, TCLP pesticides, TCLP metals, TCLP herbicides, and miscellaneous parameters. All TCLP sample results were below regulatory levels.

6.1.2.4 Influent Channel

Reportedly, prior to 1977 the Influent Channel, which is approximately 4 feet below surrounding grade, carried process and cooling waters into 3 parallel cooling lagoons that discharged into the oxidation lagoon. After 1977 the Influent Channel carried only cooling water from the cooling water ditch into the east and west cooling water lagoons. After shut down of the refinery, the cooling water conveyance was mostly used as a storm water conveyance which was later diverted directly to the Effluent Channel. This left the Influent Channel basically hydraulically isolated from the cooling water lagoons and is currently dry at most times, except after heavy rainfall events.

6.1.2.5 Effluent Channel

The Effluent Channel is an approximate 3,900 feet long by 28 feet wide by 5 feet deep ditch that runs from the northern point of the Western Lagoons to Tallaboa Bay. Reportedly, before shut down of the refinery in 1982, the effluent channel received a mixture of treated process water, cooling water and storm water. After 1982, the channel received storm water only.

CSA collected nine sediment samples from locations in the Effluent Channel in 2000. The existing data on the effluent channel are reportedly subsurface samples collected at depths of 2 to

4 feet bgs. The sample designations for the 2000 samples are DD-SED-1 through SS-SED-9. Concentrations of constituents that exceeded RSLs included: arsenic in nine samples at concentrations ranging from 3.1 to 9.6 mg/kg with the highest concentration in DD-SED-5; benzo(a)pyrene in seven samples at concentrations ranging from 290 to 3,800 ug/kg with the highest concentration in DD-SED-5; benzene in three samples at concentrations ranging from 5.6 to 2,000 ug/kg with the highest concentration in DD-SED-3; benzo(a)anthracene in four samples at concentrations ranging from 1,200 to 5,500 ug/kg with the highest concentration in DD-SED-5; and benzo(b)fluoranthene in two samples at concentrations ranging from 3,000 to 3,200 ug/kg with the highest concentration in DD-SED-3. All inorganics detections appear to be consistent with background. BTEX was detected in five samples at concentrations ranging from 40 to 10,900 ug/kg with the highest concentration in DD-SED-3.

Numerous organics were detected in multiple samples in the Effluent Channel at concentrations below the RSLs.

6.1.2.6 Surrounding Area

In August of 2000, CSA collected nine soil samples from the area west of the Oxidation Lagoon and the Aeration Lagoon. Constituents that exceeded the RSLs included: aroclor-1254 in two samples ranging from 1,800 to 2,100 ug/kg with the highest concentration in WLC-SB-6; arsenic in nine samples ranging from 3.1 to 11.6 mg/kg with the highest concentration in WLC-SB-3; benzene in one sample (WLC-SB-9) at 3,400 ug/kg; benzo(a)pyrene in two samples ranging from 260 to 790 ug/kg with the highest concentration in WLC-SB-9; dieldrin in one sample (WLC-SB-6) at 200 ug/kg; and total PCBs in one sample (WLC-SB-6) at 2,100 ug/kg. Trace levels of furans were detected and the remaining inorganics appear to be consistent with background levels within the area. Total BTEX was detected in 9 of the samples at concentrations of 33 to 80,930 ug/kg with the highest concentration in WLC-SB-6.

Numerous organics were detected in multiple samples in the surrounding areas at concentrations below the Industrial RSLs.

6.1.2.7 Groundwater

Groundwater in the Western Lagoons Area was sampled at various wells in January 1994, October 1994, September 2000, October 2000, and July 2005. Constituents that exceeded Federal MCLs included: 1,2-dichloroethane in one sample (WL-1) at a concentration of 725 ug/l; antimony in one sample (T1007-CSAW-1) at a concentration of 409 ug/l; arsenic in six samples at concentrations ranging from 68.6 to 855 ug/l with the highest concentration in T1007-CSAW-1; barium in three samples at concentrations ranging from 2,240 to 2,510 ug/l with the highest concentration in PD-02; benzene in two samples at concentrations ranging from 22,000 to 47,900 ug/l with the highest concentration in WL-1; beryllium in three samples at concentrations ranging from 23.6 to 114 ug/l with the highest concentration in T1007-CSAW-1; bis(2-ethylhexyl)phthalate in four samples at concentrations ranging from 8.0 to 190 ug/l with the highest concentration in WLC-CSAW-1; cadmium in 11 samples at concentrations ranging from 7.0 to 334 ug/l with the highest concentration in T1007-CSAW-1; chromium in eight samples at

concentrations ranging from 140 to 21,600 ug/l with the highest concentration in T1007-CSAW-1; copper in three samples at concentrations ranging from 2,620 to 2,730 ug/l with the highest concentration in PD-02; ethylbenzene in one sample (JLEI-MW-5) at a concentration of 26,000 ug/l; lead in six samples at concentrations ranging from 15.2 to 164 ug/l with the highest concentration in PD-02; selenium in one sample (T1007-CSAW-1) at a concentration of 2,670 ug/l; thallium in 14 samples at concentrations ranging from 3.2 to 1,600 ug/l with the highest concentration in WL-2; and xylenes (total) in one sample (JLEI-MW-5) at a concentration of 25,300 ug/l.

A complete listing of groundwater results are provided in Table 6-2. Figure 6-4 through 6-6 provide plots of the previous sampling results.

6.1.3 Risk Assessment

Please see Attachment C - Human Health and Ecological Risk Assessment for a description of the risk assessment.

6.1.4 Action Plan 3

The available data does not provide information on the sample depth intervals necessary to complete the ERA and HHRA. Therefore Action Plan 3 is chosen for the Western Lagoons to collect the data needed. The proposed sample locations are shown in Figure 6-8. The number of samples proposed was selected based on the need to adequately characterize the individual lagoons and the effluent channel. Best professional judgment was used along with the existing data to conclude that the lagoon sediments are relatively consistent within lagoon.

Sampling of the borings in non-lagoon areas of the WL will be by drilling as described for the Refinery Units. For the lagoon samples, these will be partially wet or underwater and will need to be collected with specialty equipment as described in Attachment C. Surface water present in the Aeration Basin and the Effluent Channel will be sampled at approximately the same location as the sediment borings. The surface water samples will be analyzed for the same parameters as the sediment samples.

6.2 Tank 1007

6.2.1 Area Description

The CSA Phase II identified the area adjacent and to the southwest of Tank 1007 for the presence of low pH materials. This area is located within the Tank 1007 secondary containment.

6.2.2 Existing Data

Although several samples were taken by CSA, none of them were tested for pH. Recent samples of groundwater in the area taken by CORCO range from pH less than 1 to 7.

6.2.3 Action Option 3

Two boring will be installed at Tank 1007 as shown on the Figure 6-8. These borings will be installed and sampled as those in the Refinery Unit. Given the possibility that acid waste disposal has occurred in this area, CORCO proposes to further evaluate this area by collecting additional pH screening samples.

6.3 Jake's Lagoon

6.3.1 Area Description

Jake's Lagoon is an area located between Guayanilla Bay and the west boundary of the Western Lagoons (Figure 6-7). According to plant personnel interviewed, the Jake's Lagoon area may have been used as an alternative cooling lagoon and waste management area in the 1960's and 1970's. Until recently, the land was owned by others but has recently been acquired by CORCO.

The northernmost section may have been used for waste management of materials from thoughout CORCO. Over time some of the material accumulated in Jake's Lagoon was reportedly moved to the Eastern Lagoon and eventually the northernmost section was filled in while the center section remains a pond area. There is a southern portion of Jake's Lagoon which is hydraulically connected to the bay due to its significantly lower elevation. No industrial activity occurred in the southern portion and no sampling is proposed for this area.

6.3.2 Existing Data

6.3.2.1 Soil

No soil data is available for the Jake's Lagoon areas.

6.3.2.2 Groundwater

Groundwater wells were installed in 2005 as part of the EI Data Gaps study (Figure 6-7). These wells are currently monitored for free product on a monthly basis as part of the ongoing monitoring program. The monitoring wells were sampled for BTEX, naphthalene and TPH in 2005. The well JLEI-MW5 had a small amount of free product reported as well as hits for dissolved BTEX, naphthalene and TPH. The wells JLEI-MW4 and 6 also had hits for these COCs.

Please see Table 6-3 for a complete list of groundwater sample results for Jake's Lagoon and the Western Lagoons.

6.3.3 Action Plan 3

6.3.3.1 Soil

CORCO proposes to sample the materials in Jake's Lagoon areas to determine whether impacts are present and to delineate these impacts. Borings will be collected from the locations shown in

Figure 6-8. The borings will be advanced to 10 feet depth or groundwater, whichever occurs first. A hand held GPS device will be used to record the approximate location of each aliquot collected so that the resulting sample location can be plotted. Additional borings may be added based on the results of the screening samples as needed for delineation. Surface water present in the southern portion of Jakes lagoon will be sampled at approximately the same locations as the 4 wet sediment samples (Figure 6-8).

6.3.3.2 Groundwater

CORCO proposes to perform as part of this RFI, dissolved constituent sampling of the groundwater monitoring wells at Jake's Lagoon. The reason is that these wells represent the boundary of Jake's Lagoon, the Main Site and Western Lagoon free product/dissolved product plume at Guayanilla Bay. The sampling will include all the JL series monitoring wells. If free product is encountered in any wells, those wells will not be sampled, but the product thickness will be recorded. Samples from each well without free product will be analyzed for SVOCs and VOCs. RCRA metals analysis may be included if soil sampling results suggest the presence of significant levels of leachable metals at Jake's Lagoon. One time dissolved constituent sampling as previously described will be performed to establish a baseline.

7.0 FLORES PENINSULA

Flores Peninsula is located in Guayanilla Bay between the Western Lagoons and the marine terminal docks (Figure 7-1). A portion of the Flores Peninsula area appeared to have been used during past refinery operations as an equipment staging and impoundment area, as well as for occasional firefighting training.

7.1 Area Description

The park area at FP includes a baseball field and pavilion that are used for outdoor company functions and parties that are traditionally held approximately twice a year. During these functions, the park area is occupied by both CORCO employees and non-employees. There is also a small pier south of the pavilion that was used in the past as a boat dock. As indicated in Section 4.3.3, a scrap yard and equipment storage area is located in the north central part of FP. In addition, the northwestern area of FP is currently used for routine maintenance dredge spoils above ground disposal within a berms system. The scrap yard and storage area is separate from the park area and is enclosed by a fence and locked gate. FP East is an open area along the eastern side which has been used for equipment staging, firefighting training and a satellite shop. Access to the scrap yard and storage area is limited and controlled by locked fencing. The scrap yard and equipment storage area are separate areas each surrounded by fences with locked gates. Each of the separate areas on the peninsula is illustrated in Figure 7-1.

Flores Peninsula occupies an area that was reclaimed from the sea and is comprised of primarily fill material believed to be compiled mostly of limestone and borrow material from the hillsides within the main facility. Mangrove trees border the peninsula on the shoreline and form a natural barrier from the bay.

Reportedly, FP was used as a firefighting training area, equipment staging, sulfur storage, a satellite shop and impoundment area in the 1980's.

7.2 Existing Data

7.2.1 Dredge Spoils Area

In July 2000, nine soil borings were collected by CSA Group from 3.5 to 4 feet bgs in the dredge spoils disposal area and were analyzed for metals, PCBs, GRO, and DRO. Aroclor-1254 was detected in sample FPP-HA-6 at a concentration of 270 ug/kg, which exceeded the RSL.

Arsenic was detected in all nine samples at concentrations ranging from 5 mg/kg to 10.1 mg/kg, all of which exceed the RSLs.

7.2.2 Employee Pavilion

In July 2000, thirteen soil borings were collected in the employee pavilion area at Flores Peninsula. Samples FP-SB-01 and FP-SB-06 were collected at depths of 8 to 12 ft bgs, FP-SB-02 was collected at a depth of 4 to 8 ft bgs, FP-SB-03, FP-SB-04, and FP-SB-12 were collected at depths of 6 to 12 ft bgs, FP-SB-05 was collected at a depth of 10 to 14 ft bgs, FP-SB-07 and FP-SB-11 were collected at depths from 10 to 12 ft bgs, FP-SB-08 was collected at 2 to 12 ft bgs, FP-SB-09 and FP-SB-10 were collected at depths from 8 to 10 ft bgs, and FP-SB-13 was collected from 6 to 8 ft bgs. All samples were analyzed for VOCs, SVOC, pesticides, PCBs, and metals.

Arsenic was detected in samples FP-SB-06 and FP-SB-11 at concentrations of 0.8 and 0.96 mg/kg, respectively, both of which exceed the Residential RSL. Arsenic was also detected in samples FP-SB-01 at 3 mg/kg, FP-SB-07 at 3.1 mg/kg, FP-SB-08 at 11.2 mg/kg, and FP-SB-09 at 5.6 mg/kg, all of which exceed the RSLs.

7.2.3 Scrap Yard

The Flores Peninsula Scrap Yard is addressed in Section 5.5.1.5.

7.2.4 Flores Peninsula East

In August 2000, six samples were collected to the east of the unpaved road by CSA. Samples FPE-SB-1, FPE-SB-2, FPE-SB-5, and FPE-SB-6 were collected at depths of 6 to 8 ft bgs while samples FPE-SB-3 and FPE-SB-4 were collected at depths of 4 to 6 ft bgs. All samples were analyzed for VOCs, SVOCs, pesticides, PCB, and metals.

Arsenic was detected in samples FPE-SB-1, FPE-SB-4, FPE-SB-5, and FPE-SB-6 at concentrations of 7.7 mg/kg, 3.2 mg/kg, 13 mg/kg, and 5.2 mg/kg, respectively, all of which exceed the RSLs.

7.2.5 Environmental Indicators Study

In June 2005, 59 soil borings on the peninsula were collected at depths of 0 to 4 feet bgs and 4 sediment samples off of the western shoreline were collected from 0 to 1 foot bgs. All samples were analyzed for BTEX, GRO, DRO, and ORO. The sediment samples were also analyzed for PAHs. Benzene was detected in sample B-55 in the dredge spoils area at a concentration of 16,000 ug/kg, which exceeded the RSLs.

Please see Table 7-1 for a complete list of soil samples collected at Flores Peninsula. Also see Figures 7-2 through 7-4 for post plots of the data.

7.2.6 Risk Assessment

Please see Attachment C - Human Health and Ecological Risk Assessment for a description of the risk assessment.

7.3 Action Plan 3

Additional borings are proposed for the peninsula as shown in Figure 7-5. The number of samples proposed is based on an understanding of the use of the subareas, existing data and for delineation purposes as necessary. In addition, VSP was used to confirm that the number of samples were adequate. The borings will be advanced to depth of 10 feet or groundwater whichever occurs first.

The existing groundwater monitoring well network adequately covers Flores Peninsula with 17 monitoring wells located around the southern perimeter of the peninsula. CORCO proposes to perform a onetime sampling event of the perimeter FP wells. Each well will be sampled and analyzed for SVOCs and VOCs. RCRA metals analysis may be included if soil sampling results suggest the presence of significant levels of leachable metals at FP. The existing groundwater data are presented in Table 7-2.

8.0 OXOCHEM/CARIBE ISOPRENE

The inactive Oxochem and Caribe Isoprene (OXO/CIC) facilities were formerly operated as joint ventures, are presently owned by CORCO and are located east of the main site (Figure 8-1).

8.1 Area Description

The OXO/CIC facilities contained process units for the production of butanols, 2-ethylhexanol and isoprene. These facilities are inoperative and were shut down in the 1980s following shutdown at CORCO. Although the process units and lines at Oxochem were reportedly drained and mothballed by their original owners/operators, this has not been verified by CORCO. The main process vessels at CIC were reportedly drained and steam cleaned by CORCO. These facilities are surrounded by fencing and locked gates with regular CORCO security patrols.

8.2 Existing Data

8.2.1 Soil

No surface soil samples have been collected from the OXO/CIC area, with the exception of PCB samples collected from former transformer locations. The transformers were drained, and there were no detections of PCBs in the surface soils above RSLs.

Subsurface soil sampling occurred in 1993, 1994, and 2000 with sample depths varying from between 1.5 ft to 8.5 ft bgs. Subsurface samples were collected for VOCs, SVOCs, and metals. There were no analytical results above RSLs for SVOCs and VOCs. The RSLs of 1.6 mg/kg for arsenic was exceeded in several samples ranging from 1.7 to 8.7 mg/kg, though it is believed to be within normal soil background levels given the ubiquitous nature of arsenic up to 16 mg/kg. The maximum concentration of arsenic was detected in location OC-SB-06.

Please see Table 8-1 for a complete list of the soil sample results for OXO/CIC. Also please see Figures 8-1 through 8-3 for post plots of the soil sample results.

8.2.2 Groundwater

There are ten groundwater monitoring wells in the OXO/CIC area. There is no groundwater use for industrial or private purposes in this area. Figure 8-4 shows the monitoring well locations. Table 8-2 provides the groundwater sample data. Groundwater sampling data from September 2000 resulted in detections in Well OXO-2 above the Federal Maximum Contaminant Levels (MCLs), of arsenic at a concentration of 11.2 ug/L, thallium at 3.6 ug/L, aroclor-1260 at 1.4 ug/L, and heptachlor epoxide at 0.10 ug/L.

Groundwater data collected in 2005 resulted in no detections of BTEX compounds. Because there are no RSLs for DRO and GRO, these results were compared to Industrial and Recreational Preliminary Remediation Goals (PRGs) obtained from the Oak Ridge National Laboratory (ORNL). There were two samples that showed detections of DRO above the ORNL Industrial

PRG of 10,000 ug/L, but less than the ORNL Recreational Preliminary Remediation Goal (PRG) of 230,000 ug/L. DRO was detected at 15,000 ug/L in well OW-5 and 25,000 ug/L in well OW-4. The ORNL Industrial PRG for GRO is 6,100 ug/L, and the ORNL Recreation PRG is 680,000 ug/L. GRO was detected at 25,000 ug/L in well IW-1 and at 6,300 ug/L well IW-2. No sampling of groundwater is proposed at OXO/CIC.

8.2.3 Risk Assessment

Please see Attachment C - Human Health and Ecological Risk Assessment for a description of the risk assessment.

8.3 Action Plan 3

Existing subsurface soil samples cover the OXO/CIC area adequately for BTEX compounds. CORCO proposes limited additional sampling in select areas for which there is limited existing data (see Figure 8-5). The number of samples proposed is based on an understanding of the use of the subareas, given the low values of the existing data and the fact that additional samples may be added for delineation purposes. The former wastewater lagoon at Oxochem is located in the northern portion of the site. Given the close proximity of the Tallaboa River, and the potential for flooding at this site, CORCO proposes to sample the former pond in the locations as indicated. A former drum under roof storage area in the northeast corner of Oxochem is also proposed for sampling. Each boring location will be installed and sampled as described for the Refinery Units. Subsurface samples will only be analyzed for RCRA metals, VPH and EPH because existing data coverage is sufficient for VOCs and SVOCs. Borings will extend to 10 feet below grade or to groundwater, whichever occurs first. Additional borings may be added during the field activities as needed to complete the delineation.

Tallaboa River

CORCO proposes to collect a total of 7 sediment samples in the Tallaboa River upstream, adjacent to and downstream of the Oxochem / CIC sites. The purpose of these samples is to evaluate Ecological risks that may be attributable to CORCO operations. These samples will be collected over the 0 – 1 foot interval and analyzed for VOCs, SVOC, VPH/EPH, TPH and RCRA metals. Please note, the Tallaboa River has many potential sources for pollutants upstream of the Site that include both point and non-point sources.

9.0 EASTERN LAGOON

It has been reported that waste material from Jake's Lagoon was moved into the Eastern Lagoon (EL) prior to enactment of RCRA in 1980 (Figure 9-1). CORCO is acquiring the EL and the transaction should be concluded soon.

9.1 Area Description

The EL was a shallow excavation on a parcel of leased property southeast of the refinery and east of the Tallaboa River. While the exact dates of alleged disposal are not known, the available information indicates the lagoons were used to dispose of materials removed from Jake's Lagoon around 1977. It is documented that no waste has been placed in the EL since the refinery closure in 1982. To properly address issues relating to the EL, CORCO has installed a fence, posted no trespassing signs and is acquiring the EL property to control the use of the EL and evaluate and resolve environmental issues relating to the EL.

The November 18, 1980 RCRA Part A permit application indicated CORCO's intent to dispose of API OWS sludge and dredged material from the Western Lagoons into the EL. There is no documentation that API OWS sludge was ever disposed in the EL; however, there is evidence that the Western Lagoons were dredged sometime in 1977 and the material was disposed in the EL. Further, the sediment quantity in the EL closely matches the reported excavation volumes from the Western Lagoon.

9.2 Existing Data

9.2.1 Soil

Several investigations have been conducted by CORCO to characterize the EL. Information presented in Document A describes the area of the EL to be approximately 280 feet by 280 feet. Additionally, data indicate that dredged materials from the Western Lagoons were deposited in the western half of the EL. The depth of the material was greatest on the western side of the EL and decreased in an easterly direction to about the middle of the EL. There is no evidence that the eastern half of the disposal site ever received any waste materials. Based on the GDC report, approximately 3,300 cubic yards of non-native material is contained in the EL.

Surface samples of depths 0 to 1 ft bgs and subsurface samples from depths 3.5 to 8 ft bgs were collected in 1992. The existing soil data are posted in Figures 9-1 through 9-3, and also listed in Table 9-1. Surface samples of depths 0 to 2 ft bgs and subsurface samples from depths 2 to 6 ft bgs were collected in 1993. Surface samples of depths 0 to 2 ft bgs and subsurface samples from depths 2 to 7.5 ft bgs were collected in 1994. Samples from depths 1 to 7 ft bgs were collected in 2006. Arsenic was detected in soil samples above the RSLs. The maximum detected concentration of arsenic was 11.7 mg/kg. Other compounds detected above the RSLs include benzene, benzo(a)anthracene, benzo(b)fluoranthene, ethylbenzene, toluene, and xylenes. The maximum concentration reported for benzene was 1,200 mg/kg, benzo(a)anthracene was 190

mg/kg, benzo(b)fluoranthene was 620 mg/kg, ethylbenzene was 960 mg/kg, toluene was 1,700 mg/kg, and xylenes was 4,200 mg/kg.

In 2006 sediment samples were collected from the EL and TCLP analytical results were used to characterize the sediment. All of the TCLP sample results indicated that the material is non-hazardous. Also, the EL sediment/soil is not listed hazardous waste.

9.2.2 Groundwater

There are four groundwater monitoring wells in the EL area, three down-gradient and one up-gradient of the lagoon. There is no groundwater use for industrial or private purposes at the EL area. Groundwater sampling data collected in 1994 resulted in detections of arsenic above the RSLs. The groundwater concentrations of arsenic ranged between 9.3 and 72.9 ug/L with the lowest concentration detected in the well up-gradient of the lagoon. Thallium was detected at concentrations ranging from 130 to 350 ug/L with the lowest concentration detected in the well up-gradient of the EL. Vanadium was detected in the groundwater at concentrations of 30 ug/L to 1,750 ug/L, with a concentration of 660 ug/L reported in the well up-gradient of the lagoon. Concentrations greater than 255.5 ug/L were greater than the MCLs. Vinyl chloride was detected at a concentration of 13 ug/L in down-gradient well EL-3, which is greater than the MCL. Trichloroethylene was detected in the up-gradient well at a concentration of 10.3 ug/L, which exceeded the MCL.

Table 9-2 provides a list of groundwater sample results for the EL area. Figures 9-1 through 9-3 provide plots of the soil data. Figure 9-4 shows the location of the groundwater monitoring wells.

9.2.3 Risk Assessment

Please see Attachment C - Human Health and Ecological Risk Assessment for a description of the risk assessment.

9.3 Action Plan 3

CORCO proposes to install the borings shown on Figure 8-5 for the EL. The borings will be installed and sampled as those described for the Refinery Units. The borings will be advanced to 10 feet or to groundwater whichever occurs first.

The groundwater wells will not be sampled at the EL pending results of the soils sampling.

10.0 NORTH OF CPI NO. 2

The Area North of CPI No. 2 is undeveloped land located north of the former process units known as CPI No. 2. The only industrial activity known to have taken place in this area were two switch yards (partially energized) for electrical power lines, an easement for public electric power transmission lines and two boiler feed water storage tanks.

10.1 Area Description

The area north of CPI No. 2 is heavily overgrown land located north of the former production units. This area was not used for manufacturing activities. The area contains two electrical switchyards which supplied power to the former manufacturing facilities east of the main areas of the Site. The area also contains two storage tanks filled historically with water used in the CPI No. 2 production units. This area does not contain active operations and is not occupied.

Near this land is also the El Mango small electrical switchyard located on the west side of the Tallaboa River.

10.2 Existing Data

There is no existing data for these areas.

10.3 Action Plan 3

CORCO proposes to install the borings shown on Figure 8-5. The borings will be installed using hand augers to one foot depth. These samples will be field screened with the PID and XRF. The analysis performed will be as those described for the Refinery Units. The samples located adjacent to the transformer station will be analyzed for PCBs.

11.0 PIPELINES AND PUMP STATIONS

11.1 Pipelines Located on the Main Areas of the Site.

These pipelines include all active and inactive pipelines which run above ground from the tank farm located in the main areas of the Site to the Guayanilla Dock (Figure 5-1). These pipelines contain 100,000 plus feet of inactive and active lines of various sizes which have carried product from the tanker vessels to the various storage tanks, the former refinery units, the truck terminal and PREPA.

The dock pipeline is approximately 6,000 feet in length and travels westward from the main areas of the Site to the CORCO's Guayanilla Docks 1 and 2. The dock pipeline was built in the 1950s and/or the 1960s along with the refinery and the petrochemical plants and is currently owned by CORCO. It began operation in 1955 when the refinery opened.

Groundwater beneath the pipelines located in the main areas of the Site was addressed in Section 5.1 – Main Areas of the Site Groundwater.

11.2 Tallaboa Pipelines

The Tallaboa pipeline is approximately 15,557 feet in length and travels from the main areas of the Site to the Tallaboa Dock in the Tallaboa Bay (Figure 11-1). CORCO does not currently operate any of the pipes in the Tallaboa pipeline nor in the Tallaboa Dock. The Tallaboa pipeline right of way contains pipes owned by CORCO and others. The Tallaboa pipeline winds its way eastward for approximately 3,500 feet to the OXO/CIC facility where it turns south and flows for another 6,900 feet until it reaches the Tallaboa Dock. The Tallaboa pipeline was also built in the 1960s along with the joint ventures in the area, which CORCO did not own at the time.

It should be noted that the Tallaboa pipeline and dock facilities are presently in use by entities other than CORCO. Contamination, if any, discovered in these areas is not the exclusive responsibility of CORCO.

11.3 Pump Stations

There are 39 pump stations throughout the CORCO main areas of the Site, which are located as shown on Figure 11-2. The pump stations are used to move various products to and from the docks and truck terminal to the storage tanks.

Groundwater associated with the pump stations was addressed in Section 5.1 – Main areas of the Site Groundwater.

11.4 Existing Data

No prior sampling events have occurred in the immediate vicinity of the Guayanilla Pipeline, Tallaboa Pipeline, or the pump stations. Any spills from these pipelines are localized and have been handled and cleaned up on a case-by-case basis. This approach will continue into the future.

11.5 Action Option 3

11.5.1 Main Areas of the Site and Tallaboa Pipelines

CORCO will identify areas of soils underneath these pipelines that by visual observation suggest the occurrence of spills. Soil samples will be collected from these selected locations. If the area of visual impact is less than 10 meters in any direction a single grab sample will be collected. If the area is greater than 10 meters in any direction, then four aliquots will collected evenly distributed across the impacted area. Additional samples may be added if the impacted area is greater than 20 meters in any direction.

The composite of the four aliquots will be screened for metals using the XRF. One sample aliquot, which has the highest PID field screening result, will be analyzed for VPH/EPH, VOCs and SVOCs. Ten percent of all samples will be collected at depths of 0 to 1 ft bgs. Deeper sample intervals may be collected from 1 ft to 4 ft bgs based on PID results in the surface sample and visual evidence suggesting possibility of vertical migration. Each of the sample aliquots that make up the composite sample will also be sent to the lab, but will be held for analysis based on the results of the composite sample. The individual sample aliquots may be analyzed to pinpoint the location of contamination, if any.

11.5.2 Pump Stations

One sample is proposed for each of the 39 pump stations. Each of these samples will be collected at the depth of 0 to 1 ft bgs. Deeper sample intervals may be collected from 1 ft to 4 ft bgs based on visual evidence suggesting possibility of vertical migration. Each sample will be analyzed for VOC, SVOCs and RCRA metals. The location of each sample within the pump station areas will be based on visual evidence of spills.

11.5.3 Groundwater

A portion of the two pipelines are covered by site wide groundwater monitoring network. For remaining outlying areas not covered by the Main Site groundwater, if there are no visual evidence of contamination problems in subsurface soil, no groundwater samples will be obtained.

12.0 CIC TANKS

The CIC Tanks are storage tanks located on property adjacent to PR Olefins Facility and north of Highway 127 (Figures 8-5 and 12-1).

12.1 Area Description

The approximately 3.5 acre tract of land contains four above ground storage tanks owned by CORCO and formerly operated by CIC. Two of the tanks, numbered 603A and 603B have 50,000 BBLS capacity while Tanks 608A and 608B have 3,000 BBLS capacity. The tanks have been reportedly cleaned and emptied; however, an inventory of the tank contents indicates that they once contained C5/C6 hydrocarbons. C5 and C6 hydrocarbons are components of naphtha which was generated and stored throughout the CORCO facility. Naphtha was also used in for the production of olefins in steam crackers.

12.2 Existing Data

No prior sampling events have occurred at the CIC Tanks area; therefore, there is no existing data for the CIC Tanks.

12.3 Action Plan 3

Borings will be installed at the locations shown in Figure 12-1. The borings will be installed and sampled as those described for the Refinery Units. Borings will be advanced to 10 feet below ground surface or to groundwater whichever occurs first.

13.0 SUMMARY AND SCHEDULE

Overall the existing data varies widely between the identified AOCs. Given the need to perform a comprehensive evaluation of these AOCs for the assessment of risk, data collection as described herein is proposed. The table below provides a summary of the sampling plan proposed for each AOC.

Table 13-1 CORCO Area RFI Action Summary

AOC	**Action Plan**	**RFI Action Summary**
Free Product	3	Continue product recovery and monthly free product thickness monitoring
Dissolved Product	3	One-time groundwater sampling round at Main Site, Western Lagoons, Jake's Lagoon and Flores Peninsula boundary wells without free product for baseline determination
Former Refinery Units / Run Down Tanks	3	Soil Sampling following completion of Refinery Units Demolition & Decommissioning
Leaded Fuel Area	2	No Further Action - Tanks 955 through 958 and 1001 through 1006
Leaded Fuel Area	3	Soil sampling remaining tanks not previously sampled leaded fuel tanks and Former Drum Storage Areas 2 (PNP) and 3 (Pump House #5)
Open Storage Areas	3	Soil sampling Drum Storage Area 1 (Procon) and Western Lagoons Storage Area
Former WWTP Components	3	Soil sampling at former separator and DAF unit
Western Lagoons	3	Soil and surface water sampling at Western Lagoons and Tank 1007
Low pH Area	3	CORCO will sample along with Tank 1007
Inland Channel	3	Soil and groundwater sampling at Western Lagoons and Tank 1007
Effluent Channel	3	Soil and surface water sampling at Western Lagoons
Jake's Lagoon	3	Soil and surface water sampling
Flores Peninsula	3	Soil and sediment sampling at Flores
Oxochem / CIC	3	Soil sampling at Oxochem / CIC Sample the sediment in the river Groundwater - No Further Action
Eastern Lagoon	3	Soil sampling at Eastern Lagoon
Pipelines and Pump Stations	3	Grab analytical soils samples at areas suspected of past spills Grab soils samples at each pump station

N. of CPI No. 2	3	Sample soils for Eco risk and around switch yards for PCBs
CIC Tanks	3	Soils samples at CIC Tanks

13.1 Contaminants of Concern

The various areas of the Site were part of a petroleum and petrochemical complex of which CORCO was a production facility. As such, the compounds evaluated and proposed for additional sampling are consistent with the materials produced and used. The baseline analyte list proposed for each sample includes VOCs and SVOCs. VPH and EPH have been added to the analyte list based on EPA requests. RCRA metals are included for areas of suspected leaded materials handling or storage, or waste disposal areas. PCBs are added in areas where electrical transformers or equipment with dielectric fluids are a concern, while pH samples will be collected exclusively in area west of Tank 1007.

13.2 Background Samples

CORCO proposes to collect samples to evaluate background concentrations. For instance, existing data indicate that arsenic concentrations are elevated above RSLs at most areas of the Site. Arsenic was not used as a raw or finished product at CORCO. It is likely that these arsenic concentrations are indicative of background concentrations, possibly associated with the limestone formations in the area. CORCO proposes to perform a background investigation for all project COCs. This will include a literature review for available information on studies and sampling results in southwest Puerto Rico. CORCO will also collect 4 soil samples to analyze for background concentrations. These background samples will be from areas with similar limestone soil types and away from any possible influence from the CORCO site or other industrial site.

13.3 Implementation Schedule

Since the Site covers such large and diverse areas of concern, CORCO proposes to perform this work in three phases. Phase 1 will address areas to the east of the main site. Phase 2 will address areas to the west and southwest of the main site. Phase 3 will then address the main site itself. CORCO also proposes to conduct the project in linear fashion with completion of the RFI process through risk assessment and corrective measures, if needed, for each Phase before proceeding to the next Phase.

Phase 1 – Eastern Lagoon, CIC Tanks, Oxochem/CIC, North of CPI No. 2, Tallaboa River and Tallaboa Pipeline.

Phase 2 – Flores Park, Jakes Lagoon and the Western Lagoons

Phase 3 – Main site tank farms, former refinery, pump stations, pipelines

Please see Figure 13-1 for the Gant Chart type schedule.